Process and Energy Impact Evaluation of the Home Energy House Call Program in Ohio

Final Report

Prepared for

Duke Energy

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Summary of Findings

Energy Savings

The measures provided in the Energy Efficiency Starter Kits, when installed and used by program participants, provide significant energy savings to the participants and to Duke Energy. For the Ohio participants, the installation of the measures provided in the kit to the 1,680 participants provides an estimated net annual energy savings of 7,180 therms, 221,908 kWh and reduced peak load by 25.502 kilowatts.

	Gross Savings	Net Savings
Annual Savings for Kit Measure Installations		
kW	50.828	25.502
kWh	453,818.2	221,907.5
Therms	13,941.2	7,180.4
Annual Savings HEHC Recommendations Installs		
kW	102.9	20.783
kWh	249,863	50,222
Therms	9,771	1,964
Total Annual Savings for Kit Measures and Recommendations		
kW	153.728	46.285
kWh	703,681.2	272,129.5
Therms	23,712.2	9,144.4
Life Cycle Kit Measure Installs		
kWh		1,743,065
Therms		72,046
Life Cycle HEHC Recommendation Installs		
kWh		748,057
Therms		25,509
Total Life Cycle Kit and HEHC Recommendations Installs		
kWh		2,491,122
Therms		97,555

On a per-participant basis, this equals first year annual gross energy savings of 197 kWhs and .019 kW per person, with a net savings of 107 kWhs and .010 kWs for the energy efficiency kit. The home energy audit report provides gross first-year annual savings of 30 kWhs and .012 kW per person. The total first year net energy savings for the kit and the audit recommendations are 38 kWs, 230,184 kWhs and 6,980 therms.

The total net lifetime savings for the Home Energy House Call Program is 1,483 kWhs and 58 therms per participant.

The impact estimates are based on survey responses of what actions were taken and the use conditions associated with these actions for the weather zone in which the participants reside. The energy savings estimates are based on DOE-2 simulations of measure impact in residential buildings. This type of modeling and assessment approach is an industry standard and can be expected to provide accurate estimates of program impact that are consistent with the accuracy of the survey information provided by the program participants.

Energy Savings Distributions

The tables below present a summary of the total savings from the program participants. Table 1 presents the gross energy savings for each of the kit measures based on the randomly sampled participant survey responses extrapolated to the program population of 1,680. Table 2 presents the expected savings after the false-response and self-selection biases are factored into the calculations. These biases are described in Section 1, Savings Distributions. Table 3 presents the net savings, which factors in the estimated program freeridership.

Table 1. First Year Gross Energy Savings of Kit Measures, All Program Participants (n=1,680)

Kit Measures	kW	kWh	Therms
15-watt CFL	8.908	107,822	-160.4
20-watt CFL	7.564	87,330	-129.9
Weather stripping	0.156	532	10.5
Outlet gaskets	0.731	2,499	49.2
Window shrink kit	5.899	9,986	132.1
Showerhead	26.855	245,053	11,948.1
Bathroom aerator	0.343	286	1,004.0
Kitchen aerator	0.372	310	1,087.6

Table 2. First Year Energy Savings of Kit Measures, Net of False-Response and Self-Reporting Bias, All Program Participants (n=1,680)

Kit Measures	kW	kWh	Therms
15-watt CFL	5.354	64,801	-96.4
20-watt CFL	4.546	52,486	-78.1
Weather stripping	0.094	320	6.3
Outlet gaskets	0.439	1,502	29.6
Window shrink kit	3.545	6,001	79.4
Showerhead	13.454	122,772	5,986.0
Bathroom aerator	0.172	143	503.0
Kitchen aerator	0.186	155	544.9

Table 3. First Year Net Energy Savings of Kit Measures, Net of False-Response, Self-Reporting Bias and Freeridership, All Program Participants (n=1,680)

Kit Measures	kW	kWh	Therms
15-watt CFL	4.002	48,439	-72.1
20-watt CFL	3.398	39,233	-58.4
Weather stripping	0.082	278	5.5
Outlet gaskets	0.440	1,506	29.6
Window shrink kit	3.368	5,701	75.4
Showerhead	13.858	126,455	6,165.6

Bathroom aerator	0.170	142	496.7
Kitchen aerator	0.184	153	538.1

Program Operations

Third-party implementer changes have taken place since this program began operation, and the program is currently switching to a new implementation provider. With this change, program operations should improve with the use of program auditors who are expected to be better trained.

The program managers have obtained expert assistance to help improve the operations of the program, particularly in the areas of improved program design, marketing and quality control procedures. The program is currently meeting its objectives within budget.

Customer Satisfaction

Based on 100 surveys done of a random sample of the 1,680 participants in Ohio, the customer's satisfaction with the program is very high with an overall satisfaction score of 9.07 on a 10-point scale. They were satisfied with the audit (9.39 out of 10) and with the energy efficiency starter kit (8.98 out of 10).

Recommendations

1. The installation rate of the window shrink kit is very low (15%). This is expected because this measure is not one that everyone wants or needs and it requires installation expertise. Once installed, it renders the window non-functioning as a ventilation tool. The cost-effectiveness of this measure should be examined to determine the installation rate needed to reach the cost-effectiveness threshold. If this installation rate cannot be met, the item should be removed from the kit. In order to obtain the cost effectiveness threshold it may be necessary for the kit to be modified in a way that increases the installation rates. For example Duke should consider the following:
    a. Include clear customer-focused, easily accessible information on the effectiveness of installing the window shrink kit so that customers see the benefit information as soon as they open the kit and look at that measure.
    b. Make sure the kit includes clear, easy-to-follow instructions on how to install the kit.

    These messages need to be easy to find and easy to understand. The amount of time a customer will be exposed to this information might be only a few seconds. The message needs to be clear and be transmitted in a few seconds. If this does not increase installation rates above the cost effectiveness threshold, the measure should be discontinued as an item in the kit.

2. Duke should determine if the level of detail provided by the auditor can be cost-effectively enhanced. During the onsite visit, the auditors may be able to increase installation rates for needed changes by interacting with the customer about the

"areas of concern" in their home. We realize that this is not always possible because of the need to rapidly move in and out of the home for what is essentially a free service to the participant. However, the time interacting with the customer may well be the most valuable part of the audit in terms of getting customers to take needed actions. An increase in auditor training to include customer interaction and approaches should be considered. This effort must balance the cost of the service and the expected increase in savings.

3. The contract calls for the implementers to train their auditors. This requirement needs to be enforced. The auditors receive one week of classroom training before they accompany a fully trained and experienced auditor for 2-3 weeks. However, in some cases auditors have gone to the field before they were fully trained. The new contract with WECC may solve this issue by using only HERS certified raters to conduct the audits. However, this should be confirmed shortly after WECC assumes the role of implementer to ensure that the auditors are fully trained.

4. The incorporation of more testing technologies, such as the use of a blower door or infrared imaging would help some customers understand the energy saving opportunities better than a simple visual examination. However, this service is costly and could harm the participation rate and interest in the program if it's done by charging the customer. Within the current program, participants can request a blower door assessment for a cost of $125. To date, only one home has requested that test since the program started in 2003. However, as energy costs and environmental issues gain in importance; more customers may be interested in this service, so it is worth promoting this aspect of the program to identify the cost and benefits associated with increase testing promotion.

5. Having personal computers in the field with the auditors will allow them to upload and process the audit information in a more efficient manner, which will allow the reports to be delivered to the participant in a timelier manner. However, that approach should not distract from a well designed report. The report should be such that it is designed using state-of-the art behavior change theories that focus on presentation and education leading to an install decision. Duke should consider having color laser printers with the auditor so that the report can be delivered and reviewed with the customer while on site.

Introduction

This document presents the evaluation report for Duke Energy's Home Energy House Call (HEHC) Program as it was administered in Kentucky. An impact analysis was performed for each of the measures in the Energy Efficiency Starter Kit and for the measures that were installed as a result of the HEHC audit. The impacts are based on engineering analysis of the impacts associated with the self-reported measure installs identified through a participant survey. Additional analysis was performed using a billing analysis comparing the pre and post program energy consumption levels of program participants.

This report is structured to provide program energy savings impact estimations per measure via the engineering analysis, and program savings based on the billing analysis results. The impact tables reporting total savings are based on the savings identified from 100 surveyed participants extrapolated to the program's total participants. The study includes participants from January 2006 through September of 2007 (n=1,680). After each of the measures are discussed individually, the report presents the estimated energy savings achieved per distributed Energy Efficiency Starter Kit through the audit.

This impact evaluation of the measures with the kits is based on surveys conducted with customers who participated in the HEHC program and who have received the kits mailed by the program. The impact of the HEHC recommendations that were implemented is based on survey responses of the actions they have taken that were at least in part caused by the audit report. The study did not use on-site verification efforts to confirm if the survey information provided by the customer is accurate or if the measures taken were correctly installed or used. The impact analysis conducted for this study was systematically adjusted downward to account for self-selection bias and potential false response bias sometimes associated with survey research of socially acceptable behaviors documented via telephone surveys. As a result, the evaluation consultants consider this study a reasonable estimate of program-induced savings.

The evaluation was conducted by TecMarket Works and BuildingMetrics with assistance from Integral Analytics. The survey instruments were developed by TecMarket Works and BuildingMetrics. The survey was administered by TecMarket Works. Integral Analytics performed the billing analysis. BuildingMetrics developed the engineering algorithms to estimate energy impacts based on the survey responses.

Methodology

This section presents the approach for conducting this assessment.

Development of the Surveys

TecMarket Works and BuildingMetrics developed a customer survey for the Home Energy House Call (HEHC) Program participants to be implemented after they have had time to install at least some if not many of the actions in the kit and the recommendations offered during the home energy audit. The survey asked the customer for information specific to each of the measures included in the Energy Efficiency Starter Kit. In addition the participant was asked to report the actions that they had taken that were caused in whole or in part by the recommendations provided in the HEHC audit report. For each measure that was installed and for each recommendation taken, the participant was asked questions pertaining to their intentions to take that action without the intervention of the program. This information was used to estimate freeridership and to calculate net energy savings.

Because of evaluation budget limitations, the survey was restricted to 100 completed surveys with program participants, however the sample size obtained appears to be reasonable. These participants were surveyed by TecMarket Works. During the survey development process it was necessary to restrict questions so that the survey did not last longer than about 10 minutes. This approach helped control the evaluation cost, but also reduced the number of questions that could be asked in order to calculate energy savings. However, this procedure did not result in overly restrictive questions. To help focus the survey, the questions asked were based on key results of an earlier study employing an identical approach for similar measures. The experience from the previous study (PER Program) allowed this study to use those questions that were most informative to the energy impact estimation process and eliminate those questions that were found to have little impact on the results of the energy savings calculations. This allowed the HEHC survey to be shorter and more focused, yet still provide the information needed to estimate savings. The surveys can be found in Appendix C: Participant Survey Protocol.

Program Impact Estimation

Impact Estimates for Kit Measures

Using the measure-specific data collected from the customer surveys, we were able to extrapolate energy savings to the HEHC Program as a whole, and for each of the kit's eight measures individually. The energy savings for each of the measures was determined through a method in which TecMarket Works and BuildingMetrics assigned the estimates of energy savings for each of the measures included in the HEHC Energy Efficiency Starter Kit. The estimates were formed via engineering estimates of savings based on survey information and on modeling results in which the calculations for the actions taken follow DOE-II residential software modeling algorithms for the expected weather in which the actions are taken. Historical weather average daily conditions were used as the predictive weather. This approach allows for reliable energy savings estimates consistent with accepted modeling approaches based on customer-provided installation and use conditions.

The items distributed in the kit include the following measures.

1. 15-watt CFL
2. 20-watt CFL
3. Weather stripping
4. Outlet gaskets
5. Window shrink kit
6. Showerhead
7. Bathroom aerator
8. Kitchen aerator

The algorithms used to calculate the impact estimates can be found in Appendix A: Impact Algorithms Used.

Freeridership and Spillover

Freeridership and spillover were calculated for each measure in the Energy Efficiency Starter Kit. The level of freeridership was determined by using the responses to three questions in the survey (found in Appendix C). The three questions and the level of freeridership and/or spillover that was applied to the energy savings are presented in the table below, using the CFL as an example measure. All other possible combinations of answers to the series of questions resulted in 0% freeridership and 0% spillover.

Table 4. Freeridership and Spillover Factors for Energy Efficiency Kit Measures

6a: Did you have any CFLs installed before you got the kit?	6b: Were you planning on buying <additional> CFLs before you got the kit?	6c: Have you purchased any CFLs since you got the kit?	% Freeridership	% Spillover
yes	yes	yes	100	
yes	yes	no	100	
yes	no	yes		75
no	no	yes		100
no	yes	no	50	
no	yes	yes	50	50
Don't Know	yes	yes	75	25
Don't Know	yes	no	50	
Don't Know	no	yes		100
yes	already installed in every place	yes	100	
yes	already installed in every place	no	100	
Don't Know	maybe	yes	25	50
yes	maybe	yes		25
yes	maybe	no	25	
no	maybe	yes		50
yes	don't know	yes		75
no	don't know	yes		100
yes	yes	don't know	100	

yes	already installed in every place	don't know	100	
don't know	yes	don't know	50	
no	yes	don't know	50	

Freeridership was also calculated for the home energy audit as an independent analysis to determine the level of participants that would have had their homes audited if the HEHC were not made available. All other possible responses to these questions were counted as 0% freeridership.

Table 5. Questions to Estimate Freeridership for the Home Energy Audit

Considering an audit before the program?	If not available through the program, would you still have purchased an audit?	If yes, would you have purchased it within a year?	% Freeridership
yes	yes	yes	100
yes	yes	no	50
yes	yes	don't know	25

Three participants responded in a manner that labeled them as a freerider, and they had a mean freeridership level of 50.00%. Over the 100 participants, the overall freeridership level for the program's audit is very low at 0.5%.

Impact Estimates for HEHC Audit and Recommendations

The participants of the Home Energy House Call Program each received an audit of their home followed up by a customized audit report with specific recommendations for improvements to their home that would increase their home's energy efficiency. In this report, we present the recommendations as they were reported to us by the random sample of 100 participants contacted during the telephone survey. We first asked them what, if any, improvements they had made to their home. We then ask if this was a recommendation that was in the audit report. If they said that yes, (it was in the audit report) we ask how influential the recommendation in the audit report was to their decision to install the item on a scale of 1 to 10.

Savings were calculated using engineering algorithms that can be found in Appendix A: Impact Algorithms Used. The gross savings are adjusted for the influence factor. For example, if they said that the influence of the audit report was a 10 on the scale, full energy impacts are presented. If they reported that the audit report had an influence factor of 8, then 80% of the energy impacts are counted as program-induced and contribute to the program energy savings estimates. Self-selection bias and false response bias are then factored in to calculate the final estimated net impact.

Billing Analysis

This analysis presents the results of the billing analysis of the Ohio Home Energy House Call (HEHC) Program. This analysis relies upon a statistical analysis of actual customer billed energy (both electricity and natural gas) consumption before and after participation in the PER program to estimate the impact of the program. Table 1 presents the results of this billing analysis.

Table 1: Ohio HEHC Average Annual Savings: Billing Analysis versus Engineering Analysis

	Billing Analysis	Engineering Analysis
kWh	468	227
Therm	36	6

For this analysis, data are available both across households (i.e., cross-sectional) and over time (i.e., time-series). With this type of data, known as "panel" data, it becomes possible to control, simultaneously, for differences across households as well as differences across periods in time through the use of a "fixed-effects" panel model specification. The fixed-effect refers to the model specification aspect that differences across homes that do not vary over the estimation period (such as square footage, heating system, etc.) can be explained, in large part, by customer-specific intercept terms that capture the net change in consumption due to the program, controlling for other factors that do change with time (e.g., the weather).

Because the consumption data in the panel model includes months before and after the installation of measures through the program, the period of program participation (or the participation window) may be defined specifically for each customer. This feature of the panel model allows for the pre-installation months of consumption to effectively act as controls for post-participation months. In addition, this model specification, unlike annual pre/post-participation models such as annual change models, does not require a full year of post-participation data. Effectively, the participant becomes their own control group, thus eliminating the need for a non-participant group. We know the exact month of participation in the program for each participant, and are able to construct customer specific models that measure the change in usage consumption immediately before and after the date of program participation, controlling for weather and customer characteristics.

The fixed effects model can be viewed as a type of differencing model in which all characteristics of the home, which (1) are independent of time and (2) determine the level of energy consumption, are captured within the customer-specific constant terms. In other words, differences in customer characteristics that cause variation in the level of energy consumption, such as building size and structure, are captured by constant terms representing each unique household.

Algebraically, the fixed-effect panel data model is described as follows:

$$y_{it} = \alpha_i + \beta x_{it} + \varepsilon_{it},$$

where:

y_{it} = energy consumption for home i during month t
α_I = constant term for site i
β = vector of coefficients
x = vector of variables that represent factors causing changes in energy consumption for home i during month t (i.e., weather and participation)
ε = error term for home i during month t.

With this specification, the only information necessary for estimation is those factors that vary month to month for each customer, and that will affect energy use, which effectively are weather conditions and program participation. Other non-measurable factors can be captured through the use of monthly indicator variables (e.g., to capture the effect of potentially seasonal energy loads).

The effect of the program, in this case the Personal Energy Report kit as well as recommended measures, is done by including a variable which is equal to one for all months after the customer received the kit and the report. The coefficient on this variable is the savings associated with the kit. In order to account for differences in billing days, the usage was normalized by days in the billing cycle. The estimated electric model is presented in Table 2.[1]

Table 2: Estimated Electricity Model – dependent variable is daily kWh usage, January 2005 through April 2008.

Independent Variable	Coefficient	t-value
Indicator variable for months after participation in program	-1.28	-2.3
Sample Size	6,345 obs (160 homes)	
R-Squared	75%	

This estimated model shows that the HEHC program (both kits and recommended measures) results in an annual savings of 468 kWh. This estimate is fairly well estimated, with the 90% confidence interval extending from savings of 140 kWh to 794 kWh per year.

The natural gas model is presented in Table 3 below.

[1] The model includes weather terms and monthly indicator terms as well as the terms presented in the variables presented in Table 1. These terms were not included in order make interpretation clearer.

Table 3: Estimated Natural Gas Model – dependent variable is daily Therm usage, January 2005 through April 2008.

Independent Variable	Coefficient	t-value
Indicator variable for months after participation in program	-0.099	-2.04
Sample Size	4,370 obs (113 homes)	
R-Squared	73%	

This estimated model shows that the HEHC program results in an annual savings of 36 Therms. This estimate has a 90% confidence interval extending from a savings of 7 Therms to 65 Therms.

Section 1: Use of the Kit

This section presents the energy impact approach and calculations for installation and use of the measures in the Energy Savings Kit that was distributed to all HEHC participants. Findings are estimated using the 100 survey responses extrapolated to the 1,680 participants of the Home Energy House Call Program.

Use of the Kit's Measures and Their Impacts

CFLs

The CFLs included in the HEHC kit were installed by more recipients than any other measure in the Energy Efficiency Starter Kit. 93% of the recipients installed the 15-watt CFL, but only 78% of them installed the 20-watt CFL. Table 6 below shows a summary of the responses to the questions about the 15-watt CFL. The same information can be found in Table 7 for the 20-watt CFL. This information indicates that only 7% of the participants had not installed their bulbs, and only 1% will not install them in the future.

Table 6. Frequency of Installation: 15-watt CFL

Installed 15w bulb	**Surveyed participants** (n=100)
Yes	93%
No	7%
Don't Know	0%
Plan to Install 15w bulb	
Yes	4%
No	1%
Don't Know	1%

Table 7. Frequency of Installation: 20-watt CFL

Installed 20w bulb	**HEHC participants surveyed** (n=100)
Yes	78%
No	18%
Don't Know	3%
Plan to Install 20w bulb	
Yes	9%
No	4%
Don't Know	2%

Using the information above and the algorithm for lighting impacts (which can be found in Appendix A), the estimate of savings for these 1,680 customers totals 12.55 kW and 148,470 kilowatt hours per year. However, the reduction in heat output from switching the incandescent to the CFL results in an increase in therm consumption of 220.9 therms per year total. Savings can be found in Table 8.

The savings per customer (as extrapolated from the surveyed participants) for either of the CFLs can also be found Table 8 below. For instance, each customer that installed the 15-watt CFL will save 69 kWhs per year (107,822 / 1,562 = 69.03). This is the average per customer savings. The real savings will of course depend on the other factors involved (the wattage of the bulb removed and hours of use). These hours of use data have been measured as part of the overall CFL analysis, and are reasonable to use and apply in this analysis

Table 9 presents the impact estimates from the planned installations of the CFLs included in the kit. These savings may or not be realized, depending on whether the customers install the items.

Table 8. Impact Estimates from the Installation of the CFL Bulbs

	Estimated Number Installed	Total kW Savings	Total kWh Savings	Total Therm Savings
15-watt CFL	1562	8.908	107,822.0	-160.4
20-watt CFL	1310	7.564	87,330.2	-129.9
Per Install →		**Mean kW Savings**	**Mean kWh Savings**	**Mean Therm Savings**
15-watt CFL		0.006	69.03	-0.1
20-watt CFL		0.006	66.66	-0.1

Table 9. Potential Impact Estimates from the Planned Installation of the CFL Bulbs

	Estimated Number Planning to Install	Total Potential kW Savings	Total Potential kWh Savings	Total Potential Therm Savings
15-watt CFL	67	0.431	5,217.2	-7.8
20-watt CFL	151	0.951	10,984.9	-16.3
Per Install (when done) →		**Mean kW Savings**	**Mean kWh Savings**	**Mean Therm Savings**
15-watt CFL		0.006	77.87	-0.12
20-watt CFL		0.006	72.75	-0.11

Weather Stripping

Just over half of the kit recipients (53%) installed the weather stripping. Given this level of installations, the savings for this measure are somewhat modest, Table 11 below shows the energy savings from these estimated 890 installations, with only 532 kilowatt hours and 10.5 therms saved per year.

Table 10. Frequency of Installation: Weather Stripping

Installed weather stripping	HEHC participants surveyed (n=100)
Yes	53%

No	36%
Don't Know	11%
Plan to install	
Yes	11%
No	37%
Don't Know	3%

Table 11. Impact Estimates from the Installation of the Weather Stripping

	Estimated Number Installed	Total kW Savings	Total kWh Savings	Total Therm Savings
Weather stripping	890	0.156	532.3	10.5
	Per Install →	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
Weather stripping		0.0	0.6	0.01

Table 12. Potential Impact Estimates from the Planned Installation of the Weather Stripping

	Estimated Number Planning to Install	Total Potential kW Savings	Total Potential kWh Savings	Total Potential Therm Savings
Weather stripping	185	0.047	160.3	3.2
	Per Install (when done) →	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
Weather stripping		0.0	0.87	0.02

Outlet Gaskets

About half of the recipients installed the outlet gaskets. The kilowatt hour savings from this measure are 2,500 kWh annually.

Table 13. Frequency of Installation: Outlet Gaskets

Installed the gaskets on outlets	HEHC participants surveyed (n=100)
Yes	45%
No	49%
Don't Know	6%
Plan to install	
Yes	14%
No	25%
Don't Know	10%

Table 14. Impact Estimates from the Installation of the Outlet Gaskets

	Estimated Number Installed	Total kW Savings	Total kWh Savings	Total Therm Savings
Outlet gaskets	756	0.731	2,498.9	49.2
	Per Install →	**Mean kW Savings**	**Mean kWh Savings**	**Mean Therm Savings**
		0.001	3.31	0.07

Table 15. Potential Impact Estimates from the Planned Installation of the Outlet Gaskets

	Estimated Number Planning to Install	Total Potential kW Savings	Total Potential kWh Savings	Total Potential Therm Savings
Outlet gaskets	235	0.289	989.1	19.5
	Per Install →	**Mean kW Savings**	**Mean kWh Savings**	**Mean Therm Savings**
		0.001	4.21	0.08

Window Shrink Kit

Most of the kit recipients did not install the window film shrink kit. Only 15% of the population installed this measure.

Table 16. Frequency of Installation: Window Film Shrink Kit

Installed window shrink kit	HEHC participants surveyed (n=100)
Yes	15%
No	76%
Don't Know	9%
Plan to install	
Yes	5%
No	63%
Don't Know	5%

With the low numbers of installations combined with the fact that the PER study (conducted on the same set of measures) found that 38% of the kits were installed on double-pane windows, the savings for this measure are also quite low.

Table 17. Impact Estimates from the Installation of the Window Film Shrink Kit

	Estimated Number Installed	Total kW Savings	Total kWh Savings	Total Therm Savings
Window shrink kit	252	5.899	9,985.6	132.1
	Per Install →	**Mean kW Savings**	**Mean kWh Savings**	**Mean Therm Savings**

		0.023	39.63	0.52

Table 18. Potential Impact Estimates from the Planned Installation of the Window Shrink Kit

	Estimated Number Planning to Install	Total Potential kW Savings	Total Potential kWh Savings	Total Potential Therm Savings
Window shrink kit	84	2.269	3,840.6	50.8
	Per Install →	**Mean kW Savings**	**Mean kWh Savings**	**Mean Therm Savings**
		0.027	45.72	0.6

Low-Flow Showerhead

A high percentage (41%) of the kit recipients installed the low-flow showerhead, with the resulting gross energy savings being high as well. Total energy savings are over 245,000 kilowatt-hours and almost 12,000 therms annually.

Table 19. Frequency of Installation: Low-Flow Showerhead

Installed the showerhead	HEHC participants surveyed (n=100)
Yes	41%
No	55%
Don't Know	4%
Plan to install	
Yes	12%
No	40%
Don't Know	4%

Table 20. Impact Estimates from the Installation of the Low-Flow Showerhead

	Number Installed	Total kW Savings	Total kWh Savings	Total Therm Savings
Showerhead	689	26.855	245,053.1	11,948.1
	Per Install →	**Mean kW Savings**	**Mean kWh Savings**	**Mean Therm Savings**
		0.039	355.66	17.34

Table 21. Potential Impact Estimates from the Planned Installation of the Low-Flow Showerhead

	Estimated Number Planning to	Total Potential kW Savings	Total Potential kWh Savings	Total Potential Therm Savings

	Install			
Showerhead	202	8.744	79,784.7	3,890.1
	Per Install →	**Mean kW Savings**	**Mean kWh Savings**	**Mean Therm Savings**
		0.043	394.97	19.26

Faucet Aerators

The customers were somewhat likely to install the faucet aerators included in the Energy Efficiency Starter Kit. Less than half of the kit recipients installed both of the aerators.

Table 22. Frequency of Installation: Bathroom Faucet Aerator

Installed the bathroom aerator	HEHC participants surveyed (n=100)
Yes	32%
No	60%
Don't Know	8%
Plan to install	
Yes	13%
No	41%
Don't Know	6%

Table 23. Frequency of Installation: Kitchen Faucet Aerator

Installed the kitchen aerator	HEHC participants surveyed (n=100)
Yes	35%
No	57%
Don't Know	8%
Plan to install	
Yes	10%
No	45%
Don't Know	2%

The energy impacts for this measure are in the table below, and indicate overall savings of almost 600 kilowatt hours per year and over 2,000 therms per year.

Table 24. Impact Estimates from the Installation of the Bathroom and Kitchen Faucet Aerators

	Number Installed	Total kW Savings	Total kWh Savings	Total Therm Savings
Bathroom aerator	537	0.343	286.1	1,004.0
Kitchen aerator	588	0.372	310.0	1,087.6
	Per Install →	**Mean kW Savings**	**Mean kWh Savings**	**Mean Therm Savings**
Bathroom aerator		0.001	0.53	1.87

Kitchen aerator		0.001	0.53	1.85

Table 25. Potential Impact Estimates from the Planned Installation of the Faucet Aerators

	Estimated Number Planning to Install	Total Potential kW Savings	Total Potential kWh Savings	Total Potential Therm Savings
Bathroom aerator	218	0.153	127.2	446.2
Kitchen aerator	168	0.105	87.4	306.8
Per Install →		Mean kW Savings	Mean kWh Savings	Mean Therm Savings
Bathroom aerator		0.001	0.58	2.05
Kitchen aerator		0.001	0.52	1.83

All Kit Measures

The Energy Efficiency Starter Kit is a kit of 8 energy efficient measures. The tables below show the relative "popularity" of each of the items for the recipients of the kits and the total savings for each of the measures based on those surveyed customers that indicated they installed the measure or plan to install the measure.

The CFLs are the most likely measure to be installed, with the kitchen aerator and outlet gaskets coming in second. Given the past responses from the PER evaluation in 2007, the customer-indicated behaviors and changes (such as number of showers, wattage of bulb replaced, etc.) means that the showerhead provides a greater amount of savings than the CFLs.

Table 26 below presents the estimated savings when the percent installation is applied to the total program population of 1,680. The total savings from those that received the kits and were randomly selected for the survey is estimated to be 453,818 kilowatt-hours and 13,941 therms annually. The kilowatt impact of the kits is estimated to be 50.828.

Table 26. Summary of Total Savings for All Installed Measures

Ohio Kits	Installed	Plan to Install	Total kW savings	Total kWh savings	Therm savings
15-watt CFL	1562	67	8.908	107,822.0	-160.4
20-watt CFL	1310	151	7.564	87,330.2	-129.9
Weather stripping	890	185	0.156	532.3	10.5
Outlet gaskets	756	235	0.731	2,498.9	49.2
Window shrink kit	252	84	5.899	9,985.6	132.1
Showerhead	689	202	26.855	245,053.1	11,948.1
Bathroom aerator	537	218	0.343	286.1	1,004.0
Kitchen aerator	588	168	0.372	310.0	1,087.6
Total Savings			**50.828**	**453,818.2**	**13,941.2**

Table 27 below shows the mean savings per measure installed. To obtain these values, the total savings for each measure was divided by the total installations, resulting in a "per install" savings value. If a customer were to install each of the measures in the kit, the "Mean Total" amount at the bottom of each table would be the average energy savings based on the responses of that group.

Table 27. Summary of Mean Savings for All Measures

Kit Measures	Mean kW per install	Mean kWh per install	Mean Therms per install
15-watt CFL	0.006	69.03	-0.1
20-watt CFL	0.006	66.66	-0.1
Weather stripping	0	0.6	0.01
Outlet gaskets	0.001	3.31	0.07
Window shrink kit	0.023	39.63	0.52
Showerhead	0.039	355.66	17.34
Bathroom aerator	0.001	0.53	1.87
Kitchen aerator	0.001	0.53	1.85
Mean Total Savings, if all measures installed	**0.077**	**535.95**	**21.46**

Savings Distributions

There are some risks associated with relying on self-reported behavioral changes, because the foundation of the savings estimates are based solely on the participant's responses, with no means to verify that the respondent has installed the kit's measures and is using them effectively. There are two main sources of bias with these types of surveys that directly impact the conclusions drawn from the responses. These sources of bias are Self-Selection Bias and False Response Bias. There is also an issue regarding the accuracy of the baseline energy use conditions used by the evaluation contractor to estimate savings in that many of these conditions need to be based on assumptions about the participant population, rather than on measurements. These three conditions impact the evaluation contractor's ability to provide accurate estimates of energy impact. These issues are discussed in more detail in the following paragraphs.

Self-Selection Bias

For this evaluation, we are using the self selection bias value of 29.9%. This value was estimated during the previous PER evaluation done in Kentucky and is likely applicable for the HEHC study as well. The self-selection bias applied in this study is described below and is taken from the text of the PER evaluation report.

PER Self-Selection Bias

The survey was sent to 5,401 PER Program participants – 3,562 customers that did not receive the kit, and 1,839 customers that did receive the Energy Efficiency Starter Kit. The data collection efforts resulted in 1,879 responses from PER participants who only received the PER (response rate = 52.8%), and 741 responses (response rate = 40.3%) from Kentucky PER participants who received the Energy Efficiency Kit. The people that filled out and returned the survey are the participants that are more likely to install measures from the Energy Efficiency Kit and consider taking actions based on the recommendations from the Personalized Energy Report. That is, they self-selected themselves to return the survey because they have a higher interest in the subject matter than the people who did not. These individuals also will often respond to a survey in order to let it be known that they did the right thing, and that they are taking steps to be more energy efficient. The customers that did not return the survey are more likely to have a lower interest in the subject matter, and are less likely to take actions. Thus, the people who returned the survey are not the typical participant, but rather are the participant that is more likely to take actions. With 47.2% of the PER group and 59.7% of the Kit group not responding, we are setting the self-selection bias used to estimate the potential range of impacts at half of the non-response rate. As a result, all estimated energy impact estimates will be discounted 29.9%[2] for customers that received the Energy Efficiency Kit and the Personalized Energy Report, and 23.6% for those that only received the Personalized Energy Report. All impact estimates will be discounted by this percentage in order to calculate the low end of the range of savings estimates for each measure and recommendation to adjust for self-selection bias. The adjustment approach is an estimate because there is no way to assign an adjustment factor for the survey without on-site verification efforts to establish a reliable bias factor. We set the factor at

[2] (59.7% response rate / 2 = 29.9% self-selection rate)

half of the non-response rate based on professional judgment from conducting surveys and metering studies of energy efficiency programs for over 28 years and interacting with the evaluation community regarding reasonable expectations and experience.

False Response Bias

False Response Bias is a problem with many self-reporting surveys. The participants respond not with the truth, but with the socially acceptable answer. In short, they lie about what measures they installed or what actions they have taken as a result of the Home Energy House Call program. False response bias is typically not a high number, but ranges from a low of two or three percent to a high of 15 percent in our experience depending on the topic and the population being tested. The False Response Bias is set at 10% for this survey, unless otherwise indicated. A 10% discount will be applied to all impact-related measure estimates to calculate the low end of the range of savings estimates for each measure and recommendation.

Baseline Energy Use Assumptions

When a mail survey is used to conduct an evaluation, the evaluation contractors are unsure of the actual conditions in the home that have experienced a change. For example, while a new showerhead may have been installed, it is impossible to estimate precise savings unless the flow rates and use conditions associated with the previous showerhead are well understood. For this study we established our baseline assumptions based on the survey results and our past research and experience with programs and program evaluations that have taken measurements of baseline conditions. We have also used housing-type computer models to estimate baseline conditions and behaviors. As a result, we are not adjusting the baseline conditions applied in this study based on on-site pre-program inspections, but rather we are using the survey results, the literature, our past research and field experience to set what we think are typical baseline conditions. However, because these are not program-participant measured baseline conditions, it is important to let the reader know that the baselines used in this study are estimated.

Level of Discounting for False Response Bias

The level of discounting used to determine the ranges for each of the measures and recommendations can be found in the table below. The self-selection bias discount factor for all measures for HEHC is 29.9%.

Measure	False Response Bias
CFLs	10%
Weatherstripping	10%
Outlet gaskets	10%
Window shrink kit	10%
Showerhead	20%
Aerators	20%

Section 2: Savings Estimates

Each of the Kit measures' savings are recalculated here in order to provide probable ranges of energy savings associated with each item. The tables below provide the gross energy savings (as extrapolated to the whole population and reported above), the savings after the self-selection bias and false reporting bias are factored in, and then the net savings which factors in freeridership and spillover using the estimates adjusted for the biases.

Table 28. Ohio Participants' Range of Kilowatt Savings – Installed Items

Measure	Total kW Savings		
	Self-Selection and False Response	Unadjusted Gross Savings	Net Savings
15-watt CFL	5.354	8.908	4.002
20-watt CFL	4.546	7.564	3.398
Weatherstripping	0.094	0.156	0.082
Outlet gaskets	0.439	0.731	0.440
Window shrink kit	3.545	5.899	3.368
Showerhead	13.454	26.855	13.858
Bathroom aerator	0.172	0.343	0.170
Kitchen aerator	0.186	0.372	0.184

Table 29. Ohio Participants' Range of Kilowatt-Hour Savings – Installed Items

Measure	Total kWh Savings		
	Self-Selection and False Response	Unadjusted Gross Savings	Net Savings
15-watt CFL	64,801.0	107,822.00	48,439.3
20-watt CFL	52,485.5	87,330.20	39,233.3
Weatherstripping	319.9	532.3	278.3
Outlet gaskets	1,501.8	2,498.90	1,505.6
Window shrink kit	6,001.3	9,985.60	5,701.3
Showerhead	122,771.6	245,053.10	126,454.8
Bathroom aerator	143.3	286.1	141.5
Kitchen aerator	155.3	310	153.4

Table 30. Ohio Participants' Range of Therm Savings – Installed Items

Measure	Total Therm Savings		
	Self-Selection and False Response	Unadjusted Gross Savings	Net Savings
15-watt CFL	-96.4	-160.4	-72.1
20-watt CFL	-78.1	-129.9	-58.4
Weatherstripping	6.3	10.5	5.5
Outlet gaskets	29.6	49.2	29.6
Window shrink kit	79.4	132.1	75.4

Showerhead	5,986.0	11,948.10	6,165.6
Bathroom aerator	503.0	1,004.00	496.7
Kitchen aerator	544.9	1,087.60	538.1

Table 31, Table 32, and Table 33 below present the potential gross and net savings from the program if those that indicated they planned to install the item do indeed install the item.

Table 31. Ohio Participants' Range of Kilowatt Savings – Planned Items

Measure	Total kW Savings		
	Self-Selection and False Response	Unadjusted Gross Savings	Net Savings
15-watt CFL	0.259	0.431	0.194
20-watt CFL	0.572	0.951	0.427
Weatherstripping	0.028	0.047	0.025
Outlet gaskets	0.174	0.289	0.174
Window shrink kit	1.364	2.269	1.295
Showerhead	4.381	8.744	4.512
Bathroom aerator	0.077	0.153	0.076
Kitchen aerator	0.053	0.105	0.052

Table 32. Ohio Participants' Range of Kilowatt-Hour Savings – Planned Items

Measure	Total kW Savings		
	Self-Selection and False Response	Unadjusted Gross Savings	Net Savings
15-watt CFL	3,135.5	5,217.20	2,343.8
20-watt CFL	6,601.9	10,984.90	4,935.0
Weatherstripping	96.3	160.3	83.8
Outlet gaskets	594.4	989.1	595.9
Window shrink kit	2,308.2	3,840.60	2,192.8
Showerhead	39,972.1	79,784.70	41,171.3
Bathroom aerator	63.7	127.2	62.9
Kitchen aerator	43.8	87.4	43.2

Table 33. Ohio Participants' Range of Therm Savings – Planned Items

Measure	Total Therm Savings		
	Self-Selection and False Response	Unadjusted Gross Savings	Net Savings
15-watt CFL	-4.7	-7.8	-3.5
20-watt CFL	-9.8	-16.3	-7.3
Weatherstripping	1.9	3.2	1.7
Outlet gaskets	11.7	19.5	11.7
Window shrink kit	30.5	50.8	29.0
Showerhead	1,948.9	3,890.10	2,007.4
Bathroom aerator	223.5	446.2	220.8
Kitchen aerator	153.7	306.8	151.8

Effective Useful Lifetime Impact Estimates

In order to calculate the estimated energy impacts over the lifetime of the measures of the kit, we used the following life-spans for each of the measures.

Kit Measures	Effective Useful Life
15-watt CFL	5
20-watt CFL	5
Weather stripping	5
Outlet gaskets	20
Window shrink kit	1
Showerhead	10
Bathroom aerator	10
Kitchen aerator	10

The peak program kilowatt impact of the installed measures in the kit remains high for the first five years at 25.5 kW, then, in year 6 the savings drop to about 14 kW. Then in year 11, kW savings drop to less than 0.5 kW for the remainder of the 20 year period.

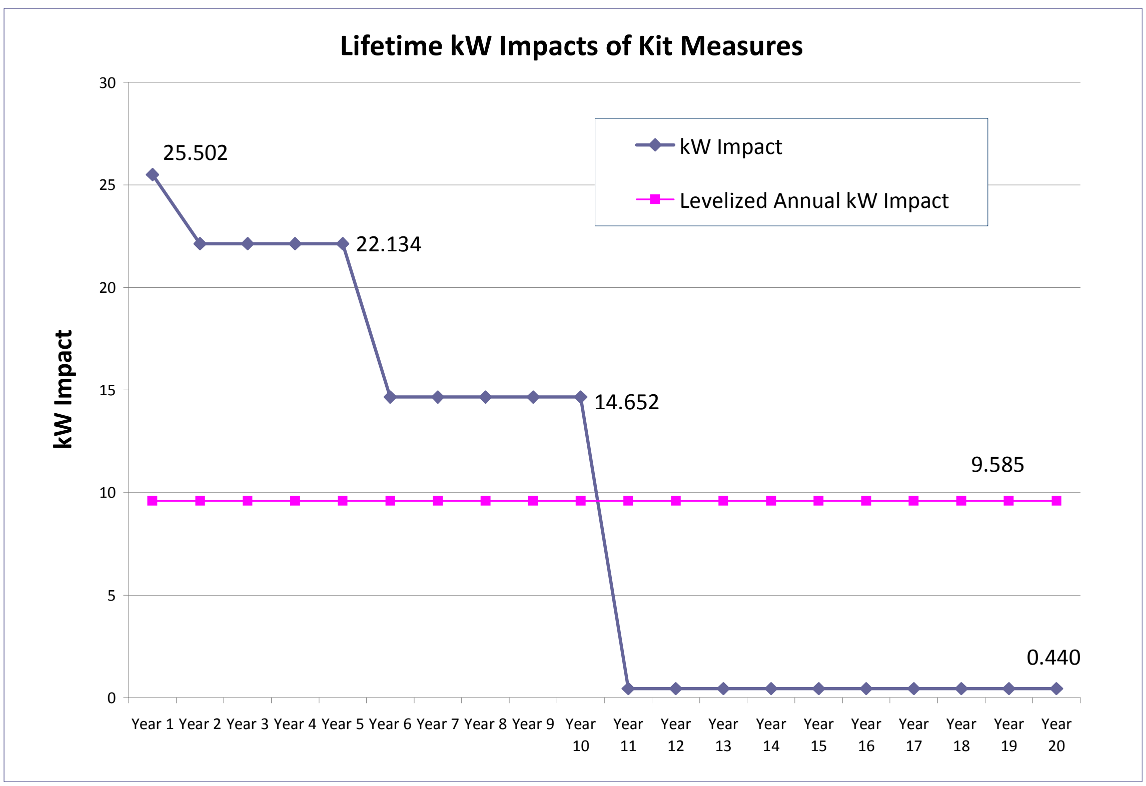

Figure 1. Lifetime kW Impacts of Kit Measures

The figure below presents the kilowatt hour savings that can be expected over the next 20 years based on the effective useful life of the installed measures. For the first five years, annual savings are close to 220,000 kilowatt hours for the 1,680 participants of the HEHC program. By year six, the savings drop to 128,000 kWhs, and in years eleven through twenty, annual kWh savings from the kit are just over 1,500 kWhs per year. The total kWh savings over the next twenty years for these 1,680 participants is 1,743,065 kWhs, a mean of 1,038 kWhs per participant.

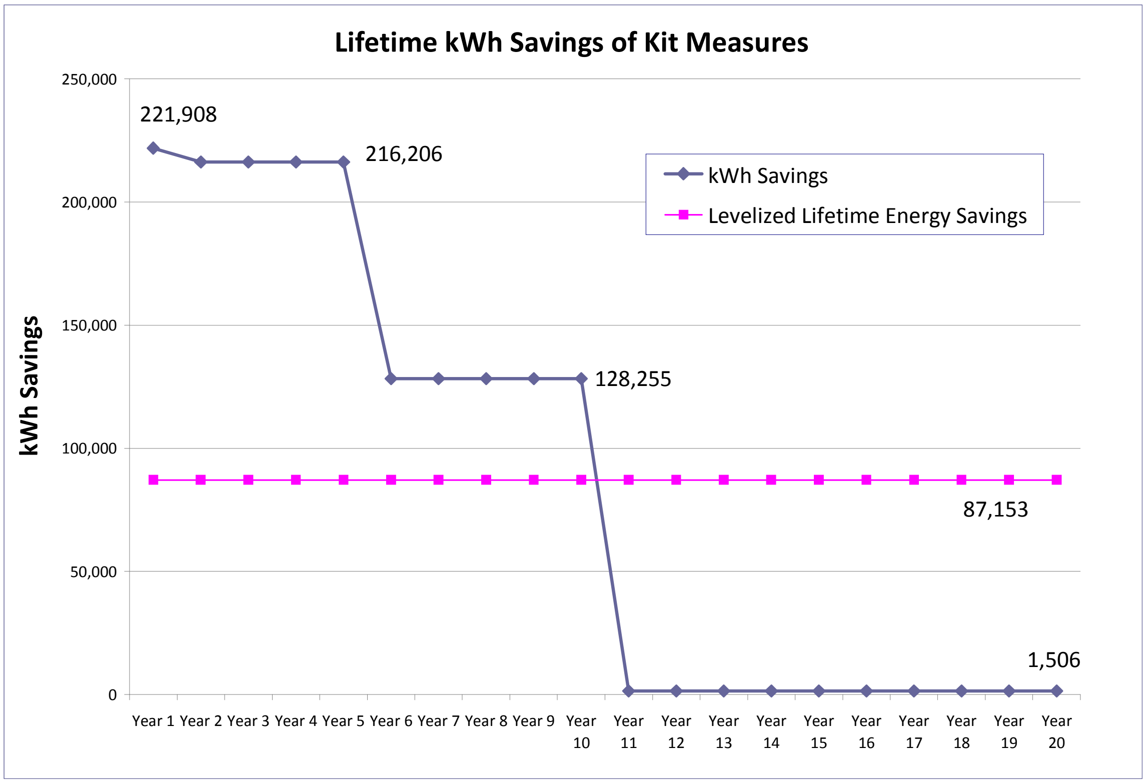

Figure 2. Lifetime kWh Savings of Kit Measures

The figure below presents the therm savings that can be expected over the next 20 years based on the effective useful life of the installed measures. For the first five years, annual savings are 7,180 therms for the 1,680 participants of the HEHC program. By year six, the savings increase slightly because the negative effect on natural gas usage caused as the gas impacts from CFLs use drops out of the equation (this assumes that the program is not the cause of continued CFL use), and in years eleven through twenty, annual therms drop drastically down to 30 therms per year. The total therm savings over the next twenty years for these 1,680 participants is 72,046 therms, a mean of 22 therms per participant. If the program causes the participant to permanently move to CFL use, the savings will continue. This savings would be market transformation savings and are not counted in this evaluation. As a result, these savings are less than what can actually be expected.

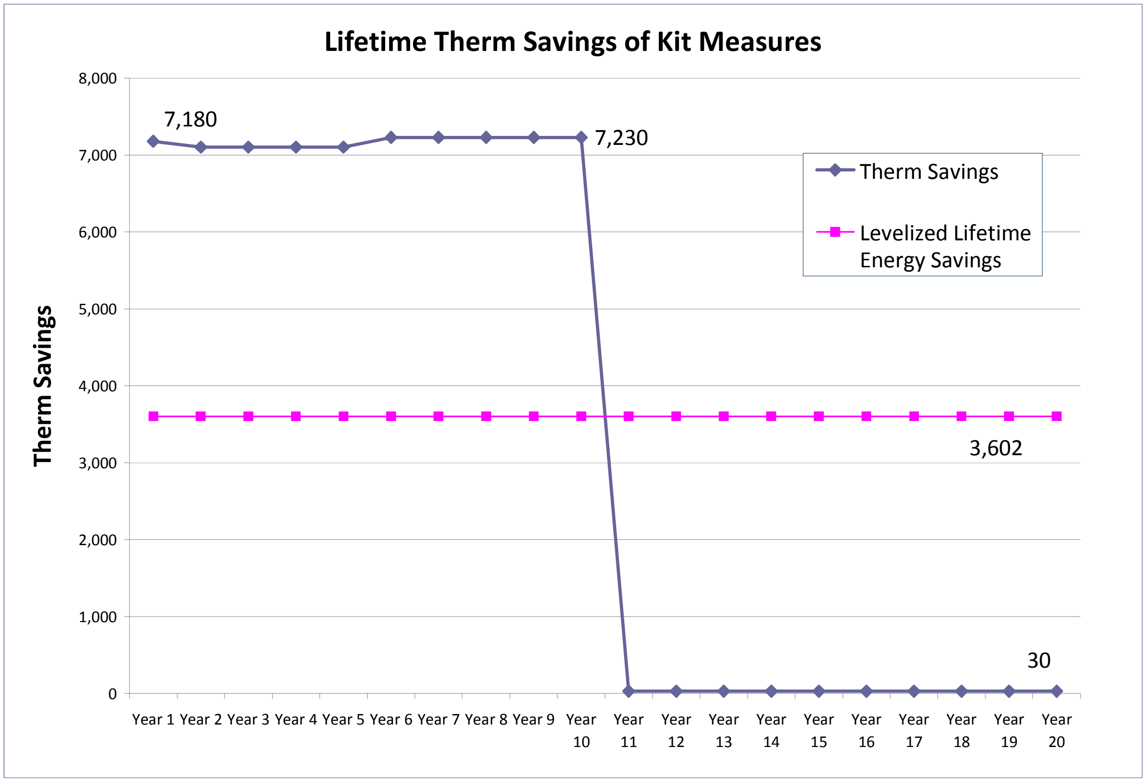

Figure 3. Lifetime Therm Savings of Kit Measures

Audit Freeridership

The Home Energy House Call audit had three (3%) participants as freeriders. To calculate freeridership, we used the following table:

Considering an audit before the program?	If not available through the program, would you still have purchased an audit?	If yes, would you have purchased it within a year?	% Freeridership
yes	yes	yes	100
yes	yes	no	50
yes	yes	don't know	25

These 3 participants had a mean freeridership level 50.00%. Over the 100 participants, the overall freeridership level for the program is 0.5%.

Savings from Audit Recommendations

The participants of the Home Energy House Call Program each received an audit of their home followed up by a customized audit report with specific recommendations for improvements to their home that would increase their home's energy efficiency. In this section, we present the recommendations as they were reported to us by the random sample of 100 participants contacted during the telephone survey. As noted in the

Methodology section above, we first asked them what, if any, improvements they made to their home. We then ask if this was a recommendation that was in the audit report. If they said that yes, it was in the audit report, we ask how influential the recommendation in the audit report was to their decision to install the item on a scale of 1 to 10.

Savings were calculated using engineering algorithms that can be found in Appendix A: Impact Algorithms Used. The gross savings are adjusted for the influence factor. For example, if they said that the influence of the audit report was a 10 on the scale, full energy impacts are presented. If they reported that the audit report had an influence factor of 8, then 80% of the energy impacts are presented and used to estimate energy savings resulting from the program. .

Table 34 below describes the actions taken by each of the respondents who indicated they took an action because of the recommendation in the audit report, the impact metrics used in calculated estimated savings, the influence factor as reported by the participant, and the program's adjusted net energy impacts without survey bias and false response adjustments.

Table 34. Actions Taken Because of the Audit Report and Net of Influence Energy Impacts

Respondent	Action Taken	Location	Algorithm Used	Influence	kW	kWh	Therms
1	Insulation	ducts	Duct insulation	9	0.152	359.3	4.6
2	UV film on windows	home	Window shrink kit	10	0.163	275.7	3.6
	Water heater blanket	basement	Insulated water heater	10	0.158	531.3	25.9
	New water heater	basement	Insulated water heater	10	0.158	531.3	25.9
	Seal duct work	home	Duct repair	10	0.219	454.7	5.4
3	New windows	home	High performance window	10	0.107	214.9	-7.3
	Insulation	home	Attic insulation	10	0.196	345.5	5.3
	Caulking	home	Window shrink kit	10	0.163	275.7	3.6
4	Water heater	basement	Insulated water heater	10	0.158	531.3	25.9
	Insulation	attic	Attic insulation	10	0.196	345.5	5.3
5	Insulation	attic	Attic insulation	9	0.176	311.0	4.8
6	Refrigerator	home	New refrigerator	10	0.210	1508.5	-1.9
	Insulation	home	Attic insulation	10	0.196	345.5	5.3
7	Water heater blanket	basement	Insulated water heater	10	0.158	531.3	25.9
8	Taped ducts	home	Duct Repair	10	0.219	454.7	5.4
9	Tighten doors	home	Weather Stripping	9	0.005	16.5	0.3
10	Insulation	home	Attic insulation	7	0.137	241.9	3.7
	Caulking	home	Window shrink kit	7	0.114	193.0	2.6

	Water heater blanket	basement	Insulated water heater	7	0.111	371.9	18.1
11	Insulated pipes	home	Pipe Wrap	8	0.153	694.5	80.0
12	New AC	outside	New AC	1	0.091	137.5	0.0
13	Insulation	attic	Attic insulation	10	0.196	345.5	5.3
14	Replaced door seal	home	Weather Stripping	10	0.005	18.3	0.4
15	Insulated water pipes	home	Pipe Wrap	10	0.191	868.1	100.0
17	Filled duct work	home	Duct Repair	10	0.219	454.7	5.4
18	Taped duct work	basement	Duct Repair	10	0.219	454.7	5.4
	Covered leaking coal chute	home	Fireplace closure	10	0.005	16.0	0.3
	Insulation	attic	Attic insulation	10	0.196	345.5	5.3
19	Taped duct work	home	Duct Repair	10	0.219	454.7	5.4
	Caulking	home	Window shrink kit	10	0.163	275.7	3.6
20	Insulation	attic	Attic insulation	10	0.196	345.5	5.3
22	Duct couples	home	Duct Repair	10	0.219	454.7	5.4
	Programmable thermostat	home	setback thermostat	10	-0.023	212.1	88.7
	Insulation	attic	Attic insulation	10	0.196	345.5	5.3
25	Sealed holes/leaks	home	Window shrink kit	10	0.163	275.7	3.6
26	Setback thermostat	home	setback thermostat	10	-0.023	212.1	88.7
	Taping duct work	home	Duct Repair	10	0.219	454.7	5.4
28	New furnace	basement	New furnace	10	0	0	16.3
	Replacement windows	home	High performance window	10	0.206	226.5	-6.9
30	Replacement windows	home	High performance window	10	0.206	226.5	-6.9
31	Caulking	home	Window shrink kit	5	0.082	137.9	1.8
34	Insulation	garage	Side wall insulation, 120ft^2	8	0.031	76.9	1.4
Total for Sample of 100 Participants					6.125	14,872.8	581.6
Mean per Participant					0.061	148.7	5.8
Total if Extrapolated to Population of 1,680 Participants					102.9	249,863	9,771

The audit recommendations resulted in an estimated net of influence savings (adjusted for influence of the audit report) of 249,863 kWhs and almost 10,000 therms when the results are extrapolated to the HEHC population.

The following presents the effective useful life and false response bias that need to be applied to these estimates.

Table 35. Effective Useful Life and False Response Bias for Audit Recommendations

	Effective Useful Life (Years)	False Response Bias
Attic insulation	20	50%
basement wall insulation	20	50%
Dishwasher	9	50%
Dryer	11	50%
Duct insulation	20	50%
Duct repair	18	50%
Fireplace closure	5	50%
High performance window	20	50%
Insulated water heater	15	50%
New AC	15	50%
New furnace	20	50%
New heat pump	15	50%
New refrigerator	12	50%
Pipe Wrap	12	10%
setback thermostat	11	50%
Side wall insulation	20	50%
Washer (clothes)	12	50%
Weather Stripping	5	50%
Window shrink kit	1	50%

After the self-response bias (discussed in Self-Selection Bias section on page 23) and the above factors are applied, the total net energy impacts can be estimated.

The kilowatt impacts of the audit recommendations over their effective useful lives are presented in Figure 4 below. The impact of the installed audit recommendations remain strong over the 20 years due to a high number of long-term measures installed by the participants, such as attic and sidewall insulation.

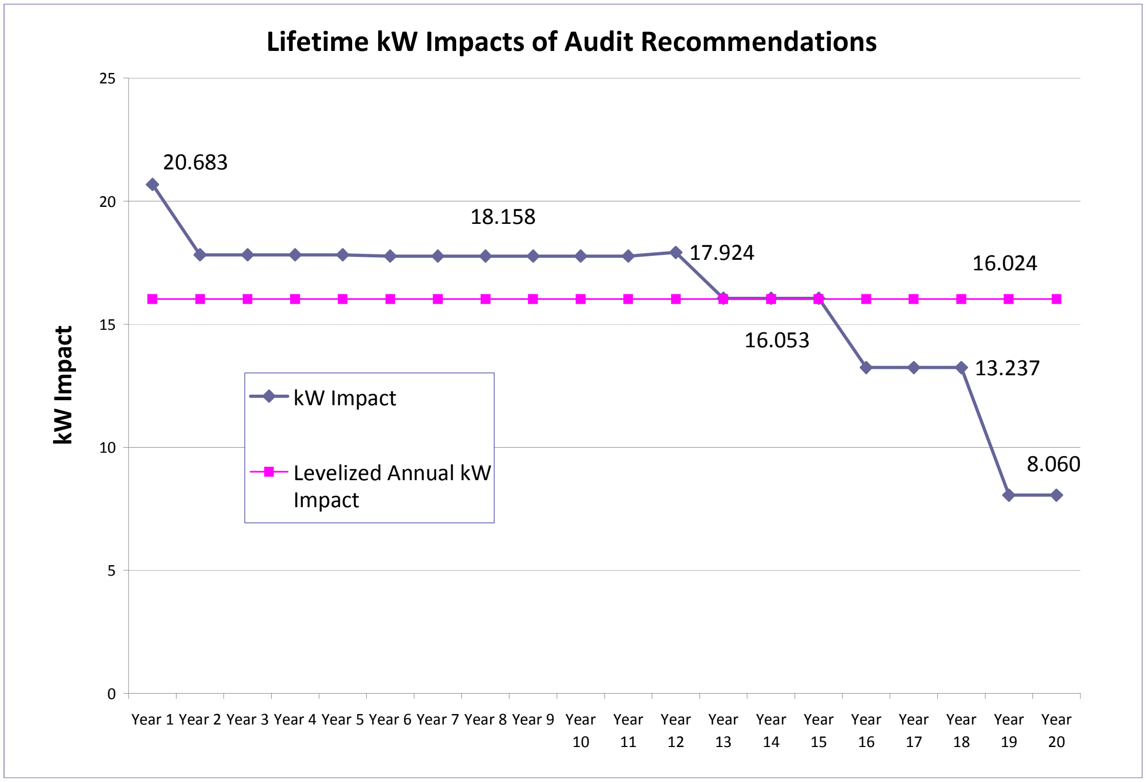

Figure 4. Lifetime kW Impacts of Audit Recommendations

The lifetime kilowatt-hour impacts are presented in Figure 5 below. The total and final net savings (net of influence, self-selection, and false-response) over the next 20 years for these installed audit recommendation is 748,057 kWhs.

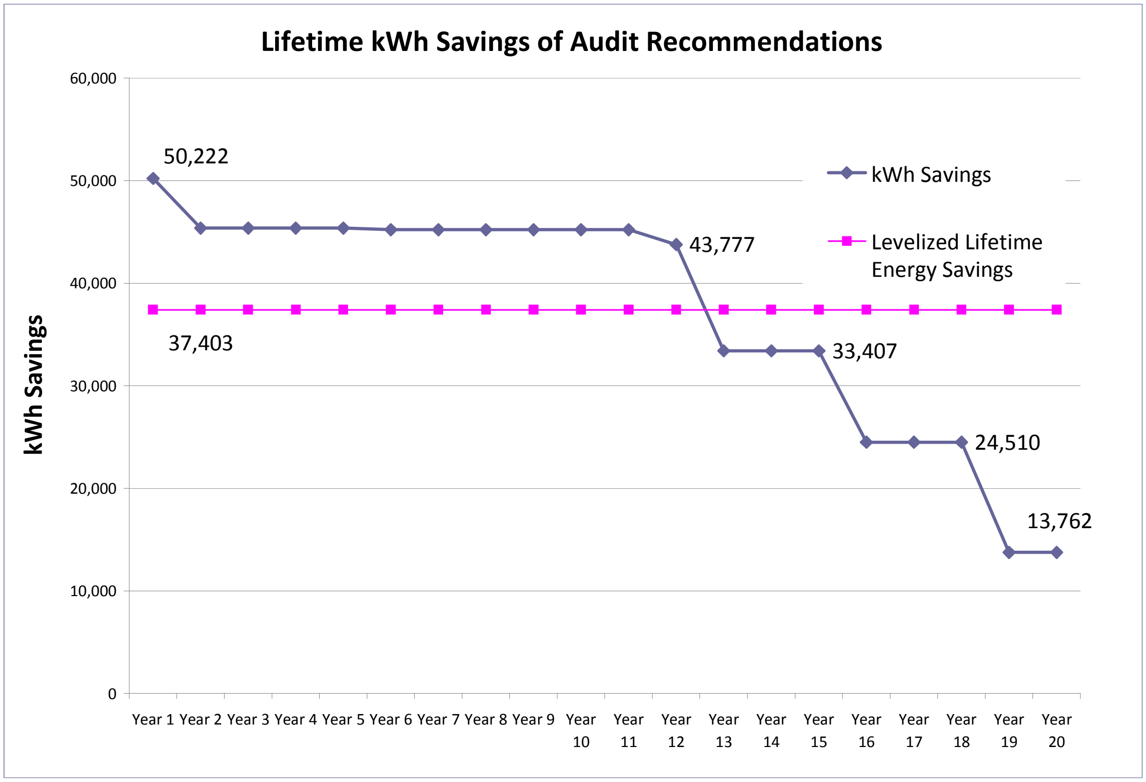

Figure 5. Lifetime kWh Savings of Audit Recommendations

Annual therm savings take a steep drop from 1,964 to 697 annual therms after twelve years, as presented below in Figure 6 below. However, the total net savings over the next twenty years for the installed measures recommended by the HEHC audit is 25,509 therms.

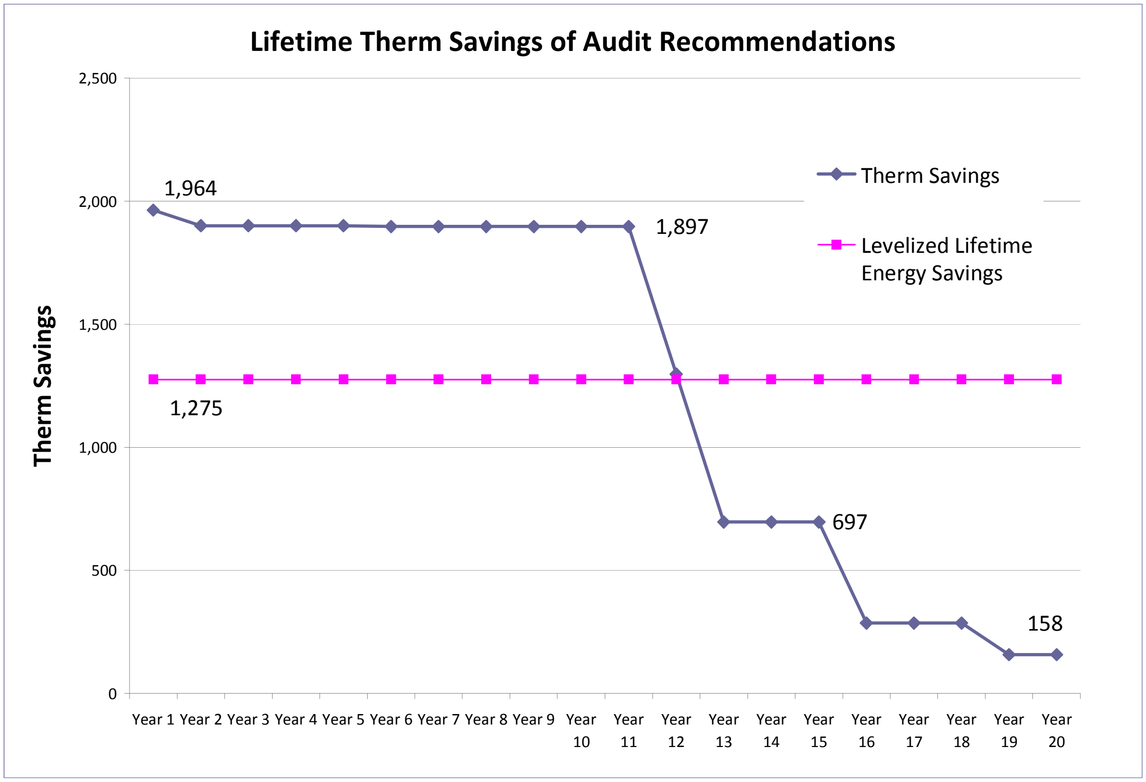

Figure 6. Lifetime Therm Savings of Audit Recommendations

Section 3: Program Operations and Customer Satisfaction

The program manager of Home Energy House Call was interviewed in July of 2008. The 100 customer surveys were performed in June-August of 2008. The interview protocol used during these interviews can be found in Appendices B and C. The results of the process interviews are report by the response categories presented below.

Program Objectives

One of the objectives of the HEHC Program is to raise customer awareness about how they use energy and to help them understand how they can affect their own bill with low cost or no cost actions, and that they can influence the environment with their activities.

This objective is being met, as customers are aware and they realize that taking the actions recommended by the audit and using the items in the kit do work to lower their energy consumption. However, according to a program manager, the level of detail provided by the auditors could be enhanced. Some auditors are better than others in the level of detail provided. In the interviews they are supposed to ask customers about "areas of concern" in their home, but sometimes they do not ask about it, or follow up on it because they forget, don't have time, or don't have the necessary knowledge to help address the issue.

A third-party contractor performs the audits. In order to minimize costs they allow 1 hour per audit and schedule 6 audits in a day. This schedule allows little time to move beyond a set of highly regimented activities, with little time for effectively communicating a complex message to customers. However, the program provides this service at no cost to the participant. As a result, the program does provide value to the participants and this value is recognized by a very high level of participant satisfaction with the program and the services provided.

From a cost effectiveness perspective, in which the program is to acquire energy savings below the avoided cost-of-supply option, the program is limited in the amount of service it can provide. Electricity (non-gas) customers have a small savings potential, providing little room for expanded services. As a result, the primary focus is on Duke's electric heat customers, or ones that use a significant amount of air conditioning (>12,000 kWh in the summer).

Program Operations

A third party contractor (GoodCents) implements the program currently. This includes operating the call center, hiring and training the auditors. The contractor has all the necessary software to collect and process the on-site audit information and translate the data into a custom report for the customers.

The program manager makes sure that the team is meeting expectations, conducts mock trainings, and sets up the on-sites visits for the auditors.

In conjunction with the contractor, the Duke program manager develops an annual marketing strategy. The marketing approach is organized by zip code targeting customers that have both electric and gas service from Duke or, in electric only territories, have high AC use in the summer.

The program enjoys a lot of media attention, especially in the fall and spring. The program manager assures that the information released about the program is accurate, coordinating messages with the contactors ability to serve.

The program has introduced the energy efficiency starter kits as a give-a-way item with the receipt of the audit. If requested, the auditor will install the items in the kit, but focuses on installing the CFL bulbs to make sure the savings are achieved.

Once the audit is completed, the report is developed and reviewed by the contractor and then mailed to the participant. The implementer reports program accomplishments and counts to Duke on a weekly basis.

Duke Energy performs periodic follow-ups and site verifications with the auditors, with assistance by Morgan Marketing Partners. There have been some adjustments to the program implementation approach as the program moved from the past contractor to a new provider (WECC).

Auditor Training

The contract calls for the implementers to train their auditors. The auditors receive one week of classroom training before they accompany a fully trained and experienced auditor for 2-3 weeks. The implementer wants to get their newly training auditing staff into the field as quickly as possible. However, in some cases auditors have gone to the field before they are fully trained. These auditors have needed additional training or coaching to develop the skills necessary to address the issues that will come up in any given house. The new contact with WECC may solve this issue by using only HERS certified raters to conduct the audits.

Implementation Changes

With the new implementation contactor moving to WECC, changes to the program are being planned. One of these changes is to make the HEHC report more user friendly and better able to convey the energy savings opportunity message to the participants. An additional change being planned is a shorter turn-around time between the audit and the delivery of the report.

Program Design

The current Home Energy House Call program was designed with input from Niagara Consulting (who helped design of the energy efficiency starter kit). Mr. Rick Morgan of Morgan Marketing Partners assists with quality review and auditor training planning. Internal Duke staff help with the development of the marketing information and manage the impact evaluation efforts.

Possible Program Improvements

The incorporation of more technologies like blower door testing or infrared imaging would help customers 'see' the energy saving opportunities; however this service is costly and could harm the participation rate and interest in the program by making it overly costly. Within the current program participants can request a blower door assessment for a cost of $125. To date, only one home has requested that test since the program started in 2003. However, as energy, energy costs and environmental issues gain in importance; more customers may be interested in this service.

Having PCs in the field with the auditors will allow them to upload and process the audit information in a more efficient manner, which will allow the reports to be delivered to the participant in a timelier manner. However, this may also be cost-prohibitive.

Participant Satisfaction Survey

One hundred of the 1,680 participants were selected at random for a telephone survey about the Home Energy House Call Program. The survey can be found in Appendix C: Participant Survey Protocol and the results of the survey are presented below.

Motivating Factors

The primary factor for participation is the customer's desire to reduce energy costs. Sixty-five percent provided this response as their primary motivating factor. The second most popular response (37% responding) was that they wanted to receive an energy audit of their home.

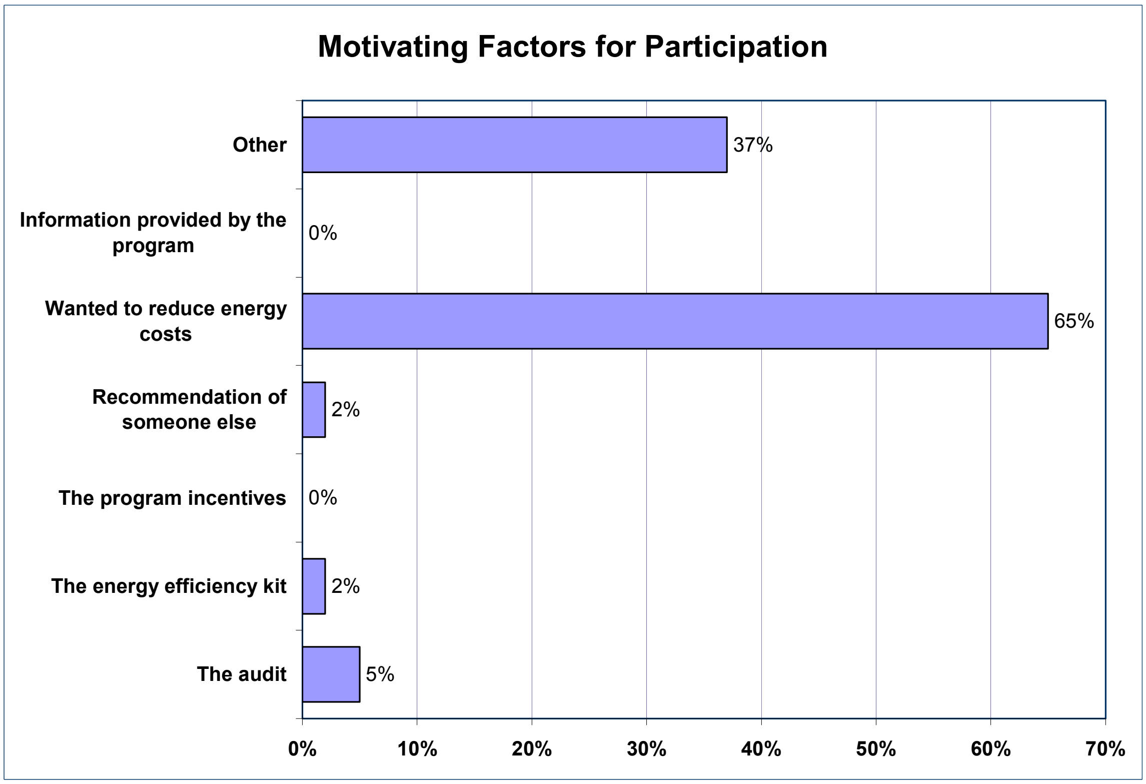

Figure 7. Motivating Factors for HEHC Participants

"Other" described:

- picked up a packet at the home show
- Big on recycling and energy saving
- conserve energy
- curious as how to save energy (n=4)
- duke asked her to
- duke shareholders
- easy
- economy
- flyer with the bill
- free and curious

- free item that was available, nothing to lose
- It was free
- look for possible improvements
- looking for something a little better
- make sure the house was efficient, get a professional opinion
- more environmental
- more responsible energy users
- New home, wanted to check heating and insulation
- new hot water heater and now water purifier
- not understanding delivery charges
- old house with leaks
- Received something in the mail
- reduce energy consumption
- Rising energy prices=primary, secondary=Audit several years from Cincinnati gas & electric. Registered professional engineer-wanted to see what level of information Duke was providing. Duke obtained a rate increase from public utility, therefore I was charged for it, consequently upset.
- save money
- see what improvements could be made
- Son is environmentalist, he told me about the program
- flyer in the bill
- Thought it might be a good deal
- To see what it was all about
- used to work for duke
- very concerned about the environment and carbon fuels

Audit Consideration

Almost a third (32%) of the surveyed participants were considering an audit of their home before enrolling in the program, but only 6% would have purchased one if they wouldn't have received one from through the program.

	Yes	No	DK/NS
Considered before HEHC	32	65	3
Purchased without HEHC	6	66	28
Purchased within a year without HEHC	2	0	4

However, as noted in Audit Consideration on page 40, only 3 of these responses resulted in the indication of any freeridership.

Energy Efficiency Purchases Since Enrollment in HEHC

Of the 100 participant surveyed, 36 indicated that they have made additional energy efficient upgrades since their enrollment in the HEHC program. These purchases are summarized in the table below.

The table shows that of the 60 improvements made by these 36 participants, 51 of them were suggested in the home audit report, and 9 were not suggested by the audit report. While the audit helps them make energy efficiency decisions, it is not the source of all of their energy efficiency actions. In order to gauge the influence of the audit in the actions taken by each home, we asked participants to rate the importance of the audit in their decision to take an action. The influence column presents the value associated with HEHC's influence on the decision to install the measure indicated. On a scale of 1 to 10, with 10 indicating that the decision was made with a very strong influence by their participation in the program, the mean response was 8.6, indicating that in most cases the program had an influence on the participant's decision to move forward and install energy efficient measures.

Respondent	Action Taken	Quantity	Location	Suggested In Audit?			How do you know it's efficient?	Influence
				Yes	*No*	*DK/NS*		
1	Insulation	1	ducts	X			Energy star rated	9
2	UV film on windows	1	home	X				10
	Water heater blanket	1	basement	X			Recommendation of auditor	10
	New water heater	1	basement	X			Energy star rated	10
	Seal duct work	1	home	X			Recommendation of auditor	10
3	New windows		home	X			Recommendation of auditor	10
	Insulation		home	X				10
	Caulking		home	X				10
4	Water heater	1	basement	X			Energy star rated	10
	Insulation	1	attic	X			Energy star rated	10
5	Insulation	1	attic	X			Recommendation of auditor	9
	Caulking	1	faucets	X			Recommendation of auditor	9
6	Refrigerator	1	home	X			Energy star rated	10
	Insulation	1	home	X			Energy star rated	10
7	Water heater blanket	1	basement	X			4 star rating	10
8	Taped ducts	1	home	X				10
	Sealed foundation	1	foundation	X				10
9	Tighten doors	1	home	X				9
	Check windows	1	home	X				9
10	Insulation	1	home	X			Energy star rated	7
	Caulking	1	home	X				7
	Water heater blanket	1	basement	X				7
11	Insulated pipes	1	home	X			Energy star rated	8
12	New AC	1	outside	X			Energy star rated	1
13	Insulation	1	attic	X			Energy star rated	10
14	Replaced door seal	1	home	X				10
15	Insulated water pipes	1	home	X			Recommendation of auditor	10
16	New furnace	1	basement	X			Energy star rated	
	New water heater	1	basement	X			Energy star rated	
17	Filled duct work	1	home	X				10

18	Taped duct work	1	basement	X				10
	Covered leaking coal chute	1	home	X				10
	Insulation	1	attic	X			Told us the height to go to	10
19	Taped duct work	1	home	X			Recommendation of auditor	10
	Caulking	1	home	X			Recommendation of auditor	10
20	Insulation	1	attic	X				
21	Air purifier w/ UV filter	1	home		X		Recommendation of Carrier	9
	Humidifier	1	home		X		Recommendation of Carrier	9
22	Duct couples	1	home	X				10
	Programmable thermostat	1	home	X				10
	Insulation	1	attic	X			Energy star rated	10
23	New furnace	1	basement	X			Recommendation of auditor	
	New heat pump	1	basement		X			
24	Removed drywall	1	basement	X				10
25	Sealed holes/leaks	1	home	X				10
26	Setback thermostat	1	home	X				10
	Taping duct work	1	home	X			Energy star rated	10
27	Storm door	1	home		X		Energy star rated	7
28	New furnace	1	basement	X			Energy star rated	10
	Replacement windows	1	home	X			Energy star rated	10
	New roof	1	roof	X			Energy star rated	10
29	Storm doors	2	home	X			Energy star rated	5
30	Replacement windows	3	home	X			Energy star rated	10
31	Insulation	1	home		X		Recommendation of auditor	5
	Caulking	1	home	X			Recommendation of auditor	5
32	Water heater	1	basement		X		Energy star rated	7
33	Front loading washer	1	laundry		X		Energy star rated	1
34	Insulation	1	garage	X			Energy star rated	8
35	Air conditioner	1	outside		X		Went from 8 to 13 SEER	1
36	Triple pane windows	8	home		X		Energy star rated	1

Program Satisfaction

The surveyed participants were very satisfied with the Home Energy House Call program. Figure 8 below shows the respondents' mean satisfaction scores with various aspects of the program.

Overall program satisfaction is very high at 9.07. Surveyed participants rated their satisfaction with the auditors who came to their homes and performed the audit. On a 1 to 10 scale, the auditors' friendliness, help and knowledge were rated a 9.35. The lowest satisfaction (7.51) was with the audit report providing new ideas for improving efficiency. These scores can be expected to improve with the new, more user friendly audit report currently being planned.

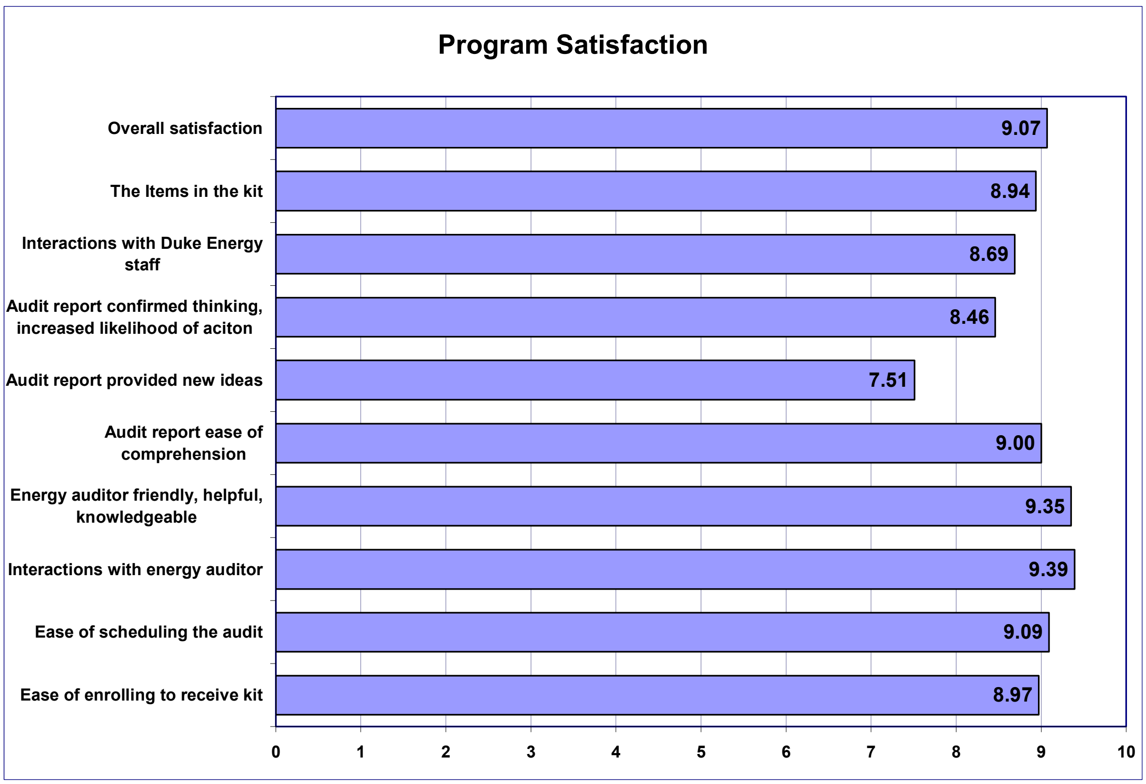

Figure 8. Program Satisfaction

Services and Program Changes Participants Would Like

We asked the 100 surveyed participants what other services they would see be a part of the HEHC program. Their responses are bulleted below:

- more information about alternative energy sources (n=5)
- cheaper electricity (n=3)
- Include a blower door test (n=2)
- have someone install the items for you (n=2)
- looking for something that would give an explanation as to why usage is so high

- windows insulation, handicap/elderly assistance
- more free perks
- more specific solutions
- provide names of places where items can be purchased or where people can be hired to do some of the work
- help with my bills
- A means of actually saving energy and money.
- If they'd provided a number for the Better Business Bureau or contractors for some of the work needed.
- Infrared camera to indicate missing insulation in walls
- New windows
- Give people information on how much it costs if they leave their computer or TV on.
- They need something for the handicapped and elderly. They should do this before winter and summer, extreme temperatures.
- A demonstration on things that are harder to visualize (techniques, products, etc)
- I'd like it to tell me in a larger way how to cut costs. Analyze my bill and see what might be wrong at certain times of the year
- more information on different programs offered through Duke
- Ability to download an electronic copy of my bill (PDF format for download)
- Research into how to reduce energy bills.
- It should be more widely promoted/advertised.
- information available for future questions or contact information in case new questions arise
- It would be helpful if they had a list of companies more friendly to people with fixed incomes.
- They could include some recommendations about behaviors or procedures to improve efficiency. Lifestyle changes.
- A follow up program to see what else can be done, make sure things were done correctly
- A follow-up audit because my bills continue to increase despite the measures I've taken
- At least provide the services they claim to provide. For example, when filling out with the auditor, there are options for additional services. One such is a blower door test, auditor was unaware of what this procedure was. Contacted Duke after the audit was received to inquire about blower test. Air infiltration is critical, and without this an energy audit is useless.
- Blower door test and infrared camera to show exactly where heat/cool air was lost
- Insulate garage underneath the house-no feedback.
- using an air infiltration test, hook up a fan to the front door and see how much air you can pull through
- Free labor to implement recommended changes
- thermal imaging camera to see where you're losing energy
- recommend someone to install the things in the kit or just do it for them, especially “dumb women” and elderly people

- IR imaging or whole house air infiltration test
- house pressure check, fan in the door test
- point out how you can get someone to take pictures and show where heat loss is
- have a fee or something to agree to an infrared house scan to see where losses are
- somebody showed you how to do some of the things in the kit

We also asked them if there were any changes they would like to see made to the program. Their responses are below:

- give averages to compare with similar homes. "Comparables."
- Bring a sheet showing how much energy different appliances use and if there is any drain when turned off.
- I'd like them to add a bill explanation specialist to explain delivery charges and explain the bill.
- perhaps some type of energy use comparison
- If they could have more auditors so people didn't have to wait as long, and they should confirm your request/approval and a time frame as to how long one must wait
- Overall thoroughness, or infrared cameras to check temperature
- ensure a reduction in my bill because the program hasn't helped me
- Funded by Duke rather than by the customers.
- decrease the time it took to get back to her about the appointment
- Information for customers on more energy efficient products and more options
- don't hire overweight auditors, get physically capable people
- letting people know about energy tax savings

We asked the surveyed participants what could be done to increase interest and participation in the program. Their suggestions are below:

- more advertisement (n=41)
- continue sending information with the bill (n=3)
- Emphasize the savings on utility bills
- watch the energy prices go up
- make them more aware of the savings
- Lower people's rates if they adopt the program
- Showing the savings
- Give discounts to those who participate
- semiannual newsletter with progress reports, promoting awareness
- Make phone calls - brochures with bills get thrown away
- If they keep raising their rates, many people will be interested
- get statements from satisfied customers
- Quit cutting down trees in Green Township
- Cost of electricity and gas doubling this winter will do it.
- a rebate for those who participate

- The rising energy costs should do that for you
- make them aware that it's a free audit
- emphasize the cost savings and the environmental impact
- show examples of before and after bills so they know how much they can save
- good PR and interaction with people
- show people where exactly they're losing their heat, would be a big selling point
- make a commercial telling people to call if they need help
- tell them how much money they can save
- Use examples to show savings from peoples' homes
- Testimonials

What Participants Liked Most

We asked the participants what they liked most about the program. Their responses are bulleted below.

- The program was free (n=15)
- The information it provided (n=12)
- The energy efficiency kit (n=10)
    - shower head
    - light bulbs
    - aerators and light bulbs
- suggestions previously not considered
- Willingness to actually come out, not just send a list of things to do
- The auditor was willing to talk and take his time and answer all questions and offered to help wherever necessary.
- savings of the light bulbs
- Duke is trying to lower energy usage free of charge.
- pretty thorough and friendly
- It was thorough and not very time consuming.
- the availability
- It was nice to get a second opinion and some new ideas
- Personal contact and personal service, and it was free
- energy audit, finding out things that I didn't know already, how to better insulate the house
- Finding out how the house rated in terms of efficiency
- The auditor was very professional and explained things very clearly and easily.
- relatively easy to set up and save some money
- It helps people save money, friendly people.
- auditor was nice, told what was needed and what wasn't
- That they made me more aware of things I can do to save money.
- The auditor.
- It shows Duke is interested in consumer consumption. It is helpful.
- I didn't expect them to come with a kit for me to implement right away

- Opportunity to have someone in my home to say specifically what to do and where.
- custom report
- Recommendations that are reasonable, it also helps new home owners take a look at what they can do to conserve energy.
- It was nice to have someone come to your home not trying to sell anything
- They supplied the items for free and helped implement them
- auditor was informative and agreeable
- Really liked the auditor. He was professional, helpful, and very polite.
- The ease of the whole thing. The report, the implementation.
- the representative was informative and nice to talk to
- It provided more energy saving ideas and methods.
- The auditor was thorough and polite and professional
- a person came out and individually looked at the house on a unique basis
- It gave a lot of people ideas they would not have thought of on their own.
- It was very efficient, they did it quickly and it was not very intrusive, it was effective.
- Nothing - it’s an intentional effort to mislead the public.
- It came with some things (kit) to increase efficiency.
- Someone came and evaluated the house without trying to sell a product. Free help.
- Convenience of scheduling and availability, representative was very prompt. I also liked the distribution of efficient items.
- Pointed out things I wasn't aware of as well as insulation that could be added to improve efficiency.
- It was very educational, I learned a lot, it was pretty nice.
- Scheduled around my time and made good recommendations.
- Very helpful
- auditor gave information to save energy that they weren't familiar with
- Duke's getting out there to help people reduce their energy costs.
- It gave me some of the recommended items rather than just suggestions
- more knowledge about saving energy, ways to cut down on use
- It educates people and gives them some directions
- They were prompt
- more information on what you could do, think it will help some people
- the courtesy
- guy came out and walked through and talked about things
- concrete suggestions you could really go out and do and see immediate benefits that were quick and easy fixes
- knowing there is something you can do to improve your lifestyle and help everyone else at the same time
- the kit was nice and unexpected
- seemed very thorough
- very friendly and knowledgeable and helped save money

- got to get in pretty quickly

What Participants Liked Least

We also asked the surveyed participants what they liked least about the program. Their responses are below.

- How long it took to get the information (audit report)
- plastic over the windows
- Nothing other than still using the same amount of energy.
- When it came to reconsideration of the bill, I could not get any help from anyone for improvements needed.
- more knowledgeable staff would be desirable
- would have liked more energy savings
- The kit - most of it didn't get used.
- the report wasn't true. They wrote up the report to look good even though everything was already done.
- Getting the audit scheduled was difficult
- Followed all suggestions by the report/auditor and bills have not decreased.
- That I followed the program and my rates still increased!
- the light bulbs and the aerator-they are not aesthetically pleasing
- The fact that the changes were implemented but the rates went up which led to nothing in savings.
- All the repairs necessary.
- Limited availability.
- The duration it took to get the report and to get someone here.
- Time it took to get it done
- The time frame and not knowing if I was eligible. And they should let you know how often you can have an audit done.
- Timing. It was difficult to schedule around peoples' jobs.
- Not a significant change in the results.
- It wasn't as high tech as I expected (thorough)
- I haven't benefited from it at all yet.
- I was surprised by the follow-up letter's timing (almost a year after the audit)
- the light bulbs
- There was a lack of communication initially and we weren't sure how long the auditor would be here. They should describe the audit in more detail prior to coming out.
- That the personnel were so grossly lacking knowledge in regards to actual energy savings.
- Some of the technical jargon wasn't clear.
- It didn't provide me with any new information
- Not very well-known, it could have been advertised more widely.
- response time to the initial submission asking for an audit, took 3 months

- The auditor didn't demonstrate or explain everything.
- It’s not advertised enough.
- Didn't realize the depth of the program
- The auditor
- wasn't anything they could do that wasn't thought of already
- could've gone further but don't know how
- mix-up with the mail in, didn't get a call from duke, had to call back
- got all the ideas and can't do them herself, needs some help installing them
- pretty cursory
- was hoping it would be more comprehensive, not much value added
- having to leave messages instead of getting to talk to the people
- wish they auditor was more personable; he just did his job, wasn't friendly

Appendix A: Impact Algorithms Used

The impact algorithms contained in this appendix are from the evaluation of the Personalized Energy Report done in 2007. This study included a mail-in survey with over 1,000 returned surveys. This evaluation of the Home Energy House Call Program included phone surveys of 100 participants and did not ask questions about heating and cooling fuels and systems in the home, size of windows, etc. Therefore, the values for these items are taken from the mean of the results of the PER results from 2007. These values are highlighted in these appendices whenever they were used.

CFLs

General Algorithm

Gross Summer Coincident Demand Savings

$$\Delta kW_S = units \times \left[\frac{(Watts \times DF_s)_{base} - (Watts \times DF_s)_{ee}}{1000}\right] \times CF_S \times (1 + HVAC_{d,\, s})$$

Gross Annual Energy Savings

$$\Delta kWh = units \times \left[\frac{(Watts \times DF)_{base} - (Watts \times DF)_{ee}}{1000}\right] \times FLH \times (1 + HVAC_c)$$

$$\Delta therm = \Delta kWh \times HVAC_g$$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
$\Delta therm$	= gross annual therm interaction
units	= number of units installed under the program
$Watts_{ee}$	= connected (nameplate) load of energy-efficient unit
$Watts_{base}$	= connected (nameplate) load of baseline unit(s) displaced
FLH	= full-load operating hours (based on connected load)
DF	= demand diversity factor
CF	= coincidence factor
$HVAC_c$	= HVAC system interaction factor for annual electricity consumption = 0.005443995
$HVAC_d$	= HVAC system interaction factor for demand =0.167018
$HVAC_g$	= HVAC system interaction factor for annual gas consumption = -0.00149

15 W CFL Measure

$Watts_{ee}$ = 15, which is the input power of program supplied CFL

$Watts_{base}$ - calculated from survey responses as shown below = 63.85514

Wattage of bulb removed	$Watts_{base}$	Notes
<= 44	40	Most popular size < 44 W
45 – 70	60	Lumen equivalent of 15 W CFL
71 – 99	75	Most popular size in range
> = 100	100	Most popular size in range

FLH - calculated from survey responses as shown below: = 1404.905 for 15-watt, 1340.106 For the 20-watt bulb.

Hours of use per day	FLH	Notes
<1	183	Average value over range
1-2	548	Average value over range
3-4	1278	Average value over range
5-10	2738	Average value over range
11-12	4198	Average value over range
13-24	6753	Average value over range

DF = 1.0 and CF = 0.10

The coincidence factor for this analysis was taken as the average of the coincidence factors estimated by PG&E and SCE for residential CFL program peak demand savings. The PG&E and SCE coincidence factors are combined factors that consider both coincidence and diversity, thus the diversity factor for this analysis was set to 1.0

$HVAC_c$ - the HVAC interaction factor for annual energy consumption depends on the HVAC system, heating fuel type, and location. The HVAC interaction factors for annual energy consumption were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix.

Covington, KY

Heating Fuel	Heating System	Cooling System	HVACc	HVACg
Other	Any except Heat Pump	Any except Heat Pump	0	0
Any	Heat Pump	Heat Pump	-0.16	0
Gas Propane Oil	Central Furnace	None	0	-0.0021
		Room/Window	0.079	-0.0021
		Central AC	0.079	-0.0021
	Other	None	0	-0.0021
		Room/Window	0.079	-0.0021

		Central AC	0.079	-0.0021
Electricity	Central furnace	None	-0.45	0
		Room/Window	-0.36	0
		Central AC	-0.36	0
	Electric baseboard	None	-0.45	0
		Room/Window	-0.36	0
		Central AC	-0.36	0
	Other	None	-0.45	0
		Room/Window	-0.36	0
		Central AC	-0.36	0

$HVAC_d$ - the HVAC interaction factor for demand depends on the cooling system type. The HVAC interaction factors for summer peak demand were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix.

Covington, KY

Cooling System	HVACd
None	0
Room/Window	.17
Central AC	.17
Heat Pump	.17

20W CFL Measure

$Watts_{ee}$ = 20, which is the input power of program supplied CFL
$Watts_{base}$ - calculated from survey responses as shown below: = 68.52787

Wattage of bulb removed	$Watts_{base}$	Notes
<= 44	40	Most popular size < 44 W
45 – 70	60	Most popular size in range
71 – 99	75	Lumen equivalent of 20 W CFL
> = 100	100	Most popular size in range

Weatherstripping, Outlet Gaskets, and Fireplace Closure

Gross Summer Coincident Demand Savings

$\Delta kW_S = \text{units} \times (\Delta cfm/unit) \times (kW / cfm) \times DF_S \times CF_S$

Gross Annual Energy Savings

$\Delta kWh = \text{units} \times (\Delta cfm/unit) \times (kWh / cfm)$

$\Delta therm = units \times (\Delta cfm / unit) \times (therm / cfm)$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
units	= number of buildings sealed under the program
Δcfm/unit	= unit infiltration airflow rate (ft^3/min) reduction for each measure
DF	= demand diversity factor = 0.8
CF	= coincidence factor = 1.0
kW/cfm	= demand savings per unit cfm reduction = 0.00164264
kWh/cfm	= electricity savings per unit cfm reduction = 4.490984952
therm/cfm	= gas savings per unit cfm reduction = 0.088377565

Unit cfm savings per measure

The cfm reductions for each measure were estimated from equivalent leakage area (ELA) change data taken from the ASHRAE Handbook of Fundamentals (ASHRAE, 2001). The equivalent leakage area changes were converted to infiltration rate changes using the Sherman-Grimsrud equation:

$$Q = ELA \text{ x } \sqrt{A \times \Delta T + B \times v^2}$$

where:

A	= stack coefficient ($ft^3/min\text{-}in^4\text{-}°F$)
	= 0.015 for one-story house
ΔT	= average indoor/outdoor temperature difference over the time interval of interest (°F)
B	= wind coefficient ($ft^3/min\text{-}in^4\text{-}mph^2$)
	= 0.0065 (moderate shielding)
v	= average wind speed over the time interval of interest measured at a local weather station at a height of 20 ft (mph)

The location specific data are shown below:

Location	Average outdoor temp	Average indoor/outdoor temp difference	Average wind speed (mph)	Specific infiltration rate (cfm/in^2)

Covington	33	35	22	1.92

Measure ELA impact and cfm reductions are as follows:

Measure	**Unit**	**ELA change (in^2/unit)**	**ΔCfm/unit (KY)**
Outlet gaskets	Each	0.357	0.69
Weather strip	Foot	0.089	0.17
Fireplace	Each	1.86	3.57

Unit energy and demand savings

The energy and peak demand impacts of reducing infiltration rates were calculated from infiltration rate parametric studies conducted using the DOE-2 residential building prototype models, as described at the end of this Appendix. The savings per cfm reduction by heating and cooling system type are shown below:

Heating Fuel	Heating System	Cooling System	kWh/cfm	kW/cfm	therm/cfm
Other	Any except Heat Pump	Any except Heat Pump	1.14	0.00000	0.000
Any	Heat Pump	Heat Pump	12.85	0.00248	0.000
Gas Propane Oil	Central Furnace	None	0	0	0.124
		Room/Window	1.14	0.00000	0.124
		Central AC	1.14	0.00000	0.124
	Other	None	0	0	0.124
		Room/Window	1.14	0.00000	0.124
		Central AC	1.14	0.00000	0.124
Electricity	Central furnace	None	23.27	0.01238	0.000
		Room/Window	23.84	0.01485	0.000
		Central AC	23.84	0.01485	0.000
	Electric baseboard	None	23.27	0.01238	0.000
		Room/Window	23.84	0.01485	0.000
		Central AC	23.84	0.01485	0.000
	Other	None	23.27	0.01238	0.000
		Room/Window	23.84	0.01485	0.000
		Central AC	23.84	0.01485	0.000

Window Shrink Kit

Gross Summer Coincident Demand Savings

ΔkW_S = no. windows ×SF/window × (ΔkW/SF) × DF_S × CF_S

Gross Annual Energy Savings
ΔkWh = no. windows ×SF/window × (ΔkWh/SF)

Δtherm = no. windows ×SF/window × (Δtherm/SF)

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
No windows	= quantity of windows treated with window film from survey
SF/window	= window square feet based on window size = 19.90221
DF	= demand diversity factor
CF	= coincidence factor
ΔkW/SF	`= electricity demand savings per square foot of window treated =0.001131
ΔkWh/SF	`= electricity consumption savings per square foot of window treated = 1.531539
Δtherm/SF	`= gas consumption savings per square foot of window treated=0.020262

Coincidence and Diversity Factors:

DF = 0.8
CF = 1.0

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for residential cooling loads in summer peaking utilities.

Window area assumptions (per window):

Window Type	Size (SF)
Small	9
Average	18
Large	30

Unit energy and demand savings data

The unit energy savings were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. The basic simulation assumptions for window U-value and solar heat gain coefficient (SHGC) were taken from the ASHRAE Handbook of Fundamentals (ASHRAE, 2001), and are described below:

	Without window film		**With window film**	
Window type	**U-value (Btu/hr-SF-°F)**	**SHGC**	**U-value (Btu/hr-SF-°F)**	**SHGC**
Single	1.27	0.86	0.81	0.76

Single with storm	0.81	0.76	0.67	0.68
Double	0.81	0.76	0.67	0.68

The unit energy savings depend on the heating fuel, heating system, cooling system and window type:

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	None

Window type	ΔkWh/SF	ΔkW/SF	Δtherm/SF
All	0	0	0

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	Room/Window or Central AC

Window type	ΔkWh/SF	ΔkW/SF	Δtherm/SF
Single	0.795	0.000853	0
Single with storm	0.566	0.000498	0
Double	0.566	0.000498	0

Heating Fuel	Any
Heating System	Heat Pump
Cooling System	Heat Pump

Window type	ΔkWh/SF	ΔkW/SF	Δtherm/SF
Single	4.757	0.001280	0.000
Single with storm	1.621	0.000711	0.000
Double	1.621	0.000711	0.000

Heating Fuel	Gas, propane or oil
Heating System	Any except Heat Pump
Cooling System	None

Window type	ΔkWh/SF	ΔkW/SF	Δtherm/SF
Single	0	0	0.039
Single with storm	0	0	0.011
Double	0	0	0.011

Heating Fuel	Gas, propane or oil

Heating System Any except Heat Pump
Cooling System Room/Window or Central AC

Window type	ΔkWh/SF	ΔkW/SF	Δtherm/SF
Single	0.795	0.000853	0.039
Single with storm	0.566	0.000498	0.011
Double	0.566	0.000498	0.011

Heating Fuel Electricity
Heating System Any except Heat Pump
Cooling System None

Window type	ΔkWh/SF	ΔkW/SF	Δtherm/SF
Single	8.748	0.004979	0.000
Single with storm	2.431	0.001351	0.000
Double	2.431	0.001351	0.000

Heating Fuel Electricity
Heating System Any except Heat Pump
Cooling System Room/Window or Central AC

Window type	ΔkWh/SF	ΔkW/SF	Δtherm/SF
Single	9.335	0.005690	0.000
Single with storm	2.940	0.001849	0.000
Double	2.940	0.001849	0.000

Low-Flow Showerhead

Gross Summer Coincident Demand Savings

$$\Delta kW_S = units \times \frac{(GPD_{base} - GPD_{ee}) \times 8.33 \times \overline{\Delta T}}{3413_s} \times DF_x \times CF_s$$

Gross Annual Energy Savings

$$\Delta kWh = units \times \frac{(GPD_{base} - GPD_{ee}) \times 8.33 \times \overline{\Delta T}}{3413} \times 365$$

$$\Delta\text{therm} = units \times \frac{(GPD_{base} - GPD_{ee}) \times 8.33 \times \overline{\Delta T}}{\eta_{waterheater}} \times \frac{365}{100000}$$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
units	= number of units installed under the program
GPD_{base}	= daily hot water consumption before installation
GPD_{ee}	= daily hot water consumption after flow reducing measure installation
ΔT	= average difference between entering cold water temperature and the shower use temperature
DF	= demand diversity factor for electric water heating
CF	= coincidence factor
8.33	= conversion factor (Btu/gal-°F)
3413	= conversion factor (Btu/kWh)
24	= conversion factor (hr/day)
365	= conversion factor (days/yr)
100000	= conversion factor (Btu/therm)

Showerhead

GPD_{base} = showers/week / 7 x 3.1 gpm x 5 minutes/shower

GPD_{ee} = showers/week / 7 x 1.5 gpm x 5 minutes/shower

ΔT

City	Average cold water temperature	Shower use temperature	Average ΔT
Covington	53.9°F	100°F	46.1°F

Water heater efficiency

Combustion efficiency for residential gas water heater = 0.70

Demand diversity factor = 0.1

Coincidence factor = 0.4

Showers/week = 8.23

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for the residential water heating end-use in a summer peaking utility.

Faucet Aerators

This measure used the Efficiency Vermont deemed savings (Efficiency Vermont, 2003) adjusted for entering water temperature:

Demand Savings
$\Delta kW = 0.0171\ kW \times \Delta T / \Delta T_{VT} \times DF \times CF$

Energy Savings
$\Delta kWh_i = 57\ kWh \times \Delta T / \Delta T_{VT}$
$\Delta therms = 2.0 \times \Delta T / \Delta T_{VT\ i}$

City	Average cold water temperature	Hot water use temperature	Average ΔT
Covington	53.9°F	100°F	46.1°F
Burlington VT	44.5	100°F	55.5

Demand diversity factor = 0.1

Coincidence factor = 0.4

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for the residential water heating end-use in a summer peaking utility.

Insulated Water Heater

Gross Summer Coincident Demand Savings

$$\Delta kW_S = units \times \frac{(UA_{base} - UA_{ee}) \times \Delta T_s}{3413} \times DF_s \times CF_s$$

Gross Annual Energy Savings

$$\Delta kWh = units \times \frac{(UA_{base} - UA_{ee}) \times \overline{\Delta T}}{3413} \times 8760$$

$$\Delta therm = units \times \frac{(UA_{base} - UA_{ee}) \times \overline{\Delta T}}{\eta_{waterheater}} \times \frac{8760}{100000}$$

where:

ΔkW = gross coincident demand savings
ΔkWh = gross annual energy savings
units = number of water heaters installed under the program
UA_{base} = overall heat transfer coefficient of base water heater (Btu/hr-°F) =4.6817
UA_{ee} = overall heat transfer coefficient of improved water heater (Btu/hr-°F)
=1.9217
ΔT = temperature difference between the tank and the ambient air (°F)
DF = demand diversity factor
CF = coincidence factor
3413 = conversion factor (Btu/kWh)
8760 = conversion factor (hr/yr)
100000 = conversion factor (Btu/therm)
$\eta_{waterheater}$ = water heater efficiency

Water heater tank UA

Water heater size (gal)	Electric		Gas	
	UAbase	UAee	UAbase	UAee
30	3.84	1.69	4.21	1.76
50	4.67	1.83	5.13	1.91
60	4.13	2.06	4.54	2.14
75	5.00	2.42	5.50	2.52
80+	5.72	2.53	6.28	2.64

ΔT = 140°F water setpoint temp – 65°F room temp = 75°F

DF = 1.0
CF= 1.0
$\eta_{waterheater} = 0.7$

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for residential water heaters meeting standby losses.

Attic Insulation

Gross Summer Coincident Demand Savings
$\Delta kW_S = SF \times (kW/SF_{base} - kW/SF_{ee}) \times DF_S \times CF_S$

$kW/SF_{base} = 0.002142316076294$
$kW/SF_{ee} = 0.002005940054496$

Gross Annual Energy Savings

$\Delta kWh = SF \times (kWh/SF_{base} - kWh/SF_{ee})$

$kWh/SF_{base} = 2.506253405995$

$kWh/SF_{ee} = 2.313866485014$

$\Delta therm = SF \times (therm/SF_{base} - therm/SF_{ee})$

$therm/SF_{base} = 0.03055422343324$

$therm/SF_{ee} = 0.02760245231608$

where:

ΔkW = gross coincident demand savings
ΔkWh = gross annual energy savings
SF = insulation square feet installed = 1796.49
DF = demand diversity factor
CF = coincidence factor
kW/SF `= electricity demand per square foot of insulation installed
kWh/SF `= electricity consumption per square foot of insulation installed
therm/SF `= gas consumption per square foot of insulation installed

Coincidence and Diversity Factors:

DF = 0.8
CF = 1.0

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for residential cooling loads in summer peaking utilities.

Insulation square foot assumptions:

Average house size from site data (Carolinas), or estimated from number of rooms (Kentucky)

Size of house = number of rooms * 330 SF/room

Average ceiling area = house size / 1.2

If partial insulation, then reduce ceiling area by 50%

R value assumptions

Rbase: = 12.19

Base thickness	R_{base}
2	7

4	14
6	21
8	28
10	35

Assumes existing insulation is fiberglass or cellulose, at R-3.5 per inch. This assumption addresses insulation R-value only. The R-value assumptions for other materials within the ceiling construction are embedded in the simulation model.

Ree =31.6011

The R-value of the wall with added insulation depends on base thickness, added insulation thickness and insulation type: Fiberglass, cellulose and "other" insulation is assumed to have an R-value of 3.5 per inch. Foam insulation is assumed to have an R-value of 5.6 per inch.

Base thickness	Added thickness	Ree	
		fiberglass, cellulose or other	Foam
	2	14.00	18.20
	4	21.00	29.40
	6	28.00	40.60
	8	35.00	51.80
	10	42.00	63.00
2	12	49.00	74.20
	2	21.00	25.20
	4	28.00	36.40
	6	35.00	47.60
	8	42.00	58.80
	10	49.00	70.00
4	12	56.00	81.20
	2	28.00	32.20
	4	35.00	43.40
	6	42.00	54.60
	8	49.00	65.80
	10	56.00	77.00
6	12	63.00	88.20
	2	35.00	39.20
	4	42.00	50.40
	6	49.00	61.60
	8	56.00	72.80
	10	63.00	84.00
8	12	70.00	95.20
10	2	42.00	46.20

	4	49.00	57.40
	6	56.00	68.60
	8	63.00	79.80
	10	70.00	91.00
	12	77.00	102.20
	2	49.00	53.20
	4	56.00	64.40
	6	63.00	75.60
	8	70.00	86.80
	10	77.00	98.00
12	12	84.00	109.20

Unit energy and demand data

The unit energy savings were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. The unit energy and demand savings depend on the heating fuel, heating system, cooling system type and Rvalue

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	None

R-value	kWh/SF	kW/SF	therm/SF
All	0	0	0

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	Room/Window or Central AC

R-value	kWh/SF	kW/SF	therm/SF
7	1.339	0.00157	0
14	1.272	0.00149	0
21	1.245	0.00145	0
28	1.231	0.00143	0
35	1.220	0.00142	0
42	1.214	0.00141	0
49	1.210	0.00141	0
56	1.206	0.00140	0
63	1.203	0.00140	0
70	1.201	0.00140	0

77	1.200	0.00140	0
84	1.196	0.00139	0
109	1.194	0.00139	0

Heating Fuel Any
Heating System Heat Pump
Cooling System Heat Pump

R-value	kWh/SF	kW/SF	therm/SF
7	6.550	0.00387	0.00000
14	6.121	0.00378	0.00000
21	5.937	0.00374	0.00000
28	5.833	0.00371	0.00000
35	5.768	0.00370	0.00000
42	5.724	0.00368	0.00000
49	5.689	0.00368	0.00000
56	5.665	0.00367	0.00000
63	5.644	0.00366	0.00000
70	5.628	0.00366	0.00000
77	5.616	0.00366	0.00000
84	5.605	0.00366	0.00000
109	5.576	0.00365	0.00000

Heating Fuel Gas, propane or oil
Heating System Any except Heat Pump
Cooling System None

R-value	kWh/SF	kW/SF	therm/SF
7	0	0	0.04418
14	0	0	0.04058
21	0	0	0.03908
28	0	0	0.03828
35	0	0	0.03768
42	0	0	0.03738
49	0	0	0.03708
56	0	0	0.03688
63	0	0	0.03668
70	0	0	0.03658
77	0	0	0.03648
84	0	0	0.03638
109	0	0	0.03618

Heating Fuel Gas, propane or oil

Heating System Any except Heat Pump
Cooling System Room/Window or Central AC

R-value	kWh/SF	kW/SF	therm/SF
7	1.339	0.00157	0.04418
14	1.272	0.00149	0.04058
21	1.245	0.00145	0.03908
28	1.231	0.00143	0.03828
35	1.220	0.00142	0.03768
42	1.214	0.00141	0.03738
49	1.210	0.00141	0.03708
56	1.206	0.00140	0.03688
63	1.203	0.00140	0.03668
70	1.201	0.00140	0.03658
77	1.200	0.00140	0.03648
84	1.196	0.00139	0.03638
109	1.194	0.00139	0.03618

Heating Fuel Electricity
Heating System Any except Heat Pump
Cooling System None

R-value	kWh/SF	kW/SF	therm/SF
7	9.063	0.00501	0.00000
14	8.254	0.00463	0.00000
21	7.915	0.00447	0.00000
28	7.728	0.00439	0.00000
35	7.610	0.00432	0.00000
42	7.528	0.00429	0.00000
49	7.468	0.00426	0.00000
56	7.423	0.00424	0.00000
63	7.387	0.00422	0.00000
70	7.358	0.00421	0.00000
77	7.334	0.00420	0.00000
84	7.313	0.00419	0.00000
109	7.262	0.00417	0.00000

Heating Fuel Electricity

Heating System	Any except Heat Pump
Cooling System	Room/Window or Central AC

R-value	kWh/SF	kW/SF	therm/SF
7	10.184	0.00646	0.00000
14	9.327	0.00601	0.00000
21	8.969	0.00581	0.00000
28	8.773	0.00571	0.00000
35	8.645	0.00564	0.00000
42	8.560	0.00560	0.00000
49	8.497	0.00557	0.00000
56	8.448	0.00554	0.00000
63	8.410	0.00552	0.00000
70	8.380	0.00551	0.00000
77	8.356	0.00550	0.00000
84	8.331	0.00548	0.00000
109	8.279	0.00546	0.00000

Sidewall Insulation

Gross Summer Coincident Demand Savings

$\Delta kW_S = SF \times (kW/SF_{base} - kW/SF_{ee}) \times DF_S \times CF_S$

$kW/SF_{base} = 0.003607765957447$

$kW/SF_{ee} = 0.003208978723404$

Gross Annual Energy Savings

$\Delta kWh = SF \times (kWh/SF_{base} - kWh/SF_{ee})$

$kWh/SF_{base} = 4.66205106383$

$kWh/SF_{ee} = 3.860968085106$

$\Delta therm = SF \times (therm/SF_{base} - therm/SF_{ee})$

$therm/SF_{base} = 0.05971$

$therm/SF_{ee} = 0.04533334042553$

where:

ΔkW = gross coincident demand savings
ΔkWh = gross annual energy savings
SF = insulation square feet installed = 1960.03
DF = demand diversity factor
CF = coincidence factor
kW/SF `= electricity demand per square foot of insulation installed
kWh/SF `= electricity consumption per square foot of insulation installed

therm/SF `= gas consumption per square foot of insulation installed

Coincidence and Diversity Factors:

DF = 0.8
CF = 1.0

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for residential cooling loads in summer peaking utilities.

Insulation square foot assumptions:

Average house size from site data (Carolinas), or estimated from number of rooms (KY)

Size of house = number of rooms * 330 SF/room

Number of walls	Wall area as a fraction of floor area
1	0.26
2	0.52
3	0.72
4+	0.92

R value assumptions

Rbase:

Base thickness	R_{base}
0	0.91

The base case assumes an uninsulated wall with 3.5 inch air gap. This assumption addresses “insulation” R-value only. The R-value assumptions for other materials within the wall construction are embedded in the simulation model.

Ree

The insulated wall R-value depends on added insulation thickness and insulation type. Fiberglass, cellulose and “other” insulation is assumed to have an R-value of 3.5 per inch. Foam insulation is assumed to have an R-value of 5.6 per inch.

Added thickness	Ree	
	fiberglass, cellulose or other	Foam
1-3	7.9	12.1
4-6	18.4	28.9
7-12	30.7	48.5

13+	46.4	73.7

Unit energy and demand data

The unit energy and demand savings were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. The unit energy and demand savings depend on the heating fuel, heating system, cooling system type and wall Rvalue:

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	None

R-value	kWh/SF	kW/SF	therm/SF
All	0	0	0

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	Room/Window or Central AC

R-value	kWh/SF	kW/SF	therm/SF
0.91	2.361	0.00273	0
7.9	2.046	0.00238	0
18.4	1.950	0.00227	0
30.7	1.908	0.00224	0
46.4	1.887	0.00220	0
12.1	1.988	0.00230	0
28.9	1.917	0.00224	0
48.5	1.886	0.00220	0
73.7	1.874	0.00220	0

Heating Fuel	Any
Heating System	Heat Pump
Cooling System	Heat Pump

R-value	kWh/SF	kW/SF	therm/SF
0.91	12.078	0.00655	0.00000
7.9	9.865	0.00605	0.00000
18.4	9.160	0.00588	0.00000
30.7	8.892	0.00581	0.00000
46.4	8.734	0.00578	0.00000

12.1	9.477	0.00597	0.00000
28.9	8.918	0.00583	0.00000
48.5	8.721	0.00578	0.00000
73.7	8.620	0.00575	0.00000

Heating Fuel	Gas, propane or oil
Heating System	Any except Heat Pump
Cooling System	None

R-value	kWh/SF	kW/SF	therm/SF
0.91	0	0	0.08530
7.9	0	0	0.06565
18.4	0	0	0.05974
30.7	0	0	0.05751
46.4	0	0	0.05623
12.1	0	0	0.06230
28.9	0	0	0.05767
48.5	0	0	0.05623
73.7	0	0	0.05543

Heating Fuel	Gas, propane or oil
Heating System	Any except Heat Pump
Cooling System	Room/Window or Central AC

R-value	kWh/SF	kW/SF	therm/SF
0.91	2.361	0.00273	0.08530
7.9	2.046	0.00238	0.06565
18.4	1.950	0.00227	0.05974
30.7	1.908	0.00224	0.05751
46.4	1.887	0.00220	0.05623
12.1	1.988	0.00230	0.06230
28.9	1.917	0.00224	0.05767
48.5	1.886	0.00220	0.05623
73.7	1.874	0.00220	0.05543

Heating Fuel	Electricity
Heating System	Any except Heat Pump
Cooling System	None

R-value	kWh/SF	kW/SF	therm/SF
0.91	17.807	0.00963	0
7.9	13.354	0.00749	0
18.4	12.045	0.00685	0
30.7	11.552	0.00663	0
46.4	11.277	0.00650	0
12.1	12.616	0.00712	0
28.9	11.599	0.00665	0
48.5	11.254	0.00649	0
73.7	11.075	0.00641	0

Heating Fuel	Electricity
Heating System	Any except Heat Pump
Cooling System	Room/Window or Central AC

R-value	kWh/SF	kW/SF	therm/SF
0.91	12.078	0.00655	0.00000
7.9	9.865	0.00605	0.00000
18.4	9.160	0.00588	0.00000
30.7	8.892	0.00581	0.00000
46.4	8.734	0.00578	0.00000
12.1	9.477	0.00597	0.00000
28.9	8.918	0.00583	0.00000
48.5	8.721	0.00578	0.00000
73.7	8.620	0.00575	0.00000

Duct Insulation and Repair

Gross Summer Coincident Demand Savings
$\Delta kW_S = (\Delta kW/unit) \times DF_S \times CF_S \times LF$

Gross Annual Energy Savings
$\Delta kWh = (\Delta kWh/unit) \times LF$

$\Delta therm = (\Delta therm/unit) \times LF$

where:

ΔkW = gross coincident demand savings
ΔkWh = gross annual energy savings
DF = demand diversity factor

CF = coincidence factor
LF = location factor = 0.43
ΔkWunit `= electricity demand savings per dwelling
Insulate = 0.4898181818182
Repair = 0.6379347826087

ΔkWh/SF `= electricity consumption savings per dwelling
Insulate = 928.438961039
Repair = 1057.532608696

Δtherm/SF `= gas consumption savings dwelling
Insulate = 11.83695652174
Repair = 12.58181818182

Coincidence and Diversity Factors:

DF = 0.8
CF = 1.0

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for residential air conditioners and heat pumps in summer peaking utilities.

The location factors used are as follows:

Heated Area	Unheated Area	DK/No Response
0	1	.43

Unit energy and demand savings data

The unit energy and demand savings were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. The basic assumptions are listed below:

Assumption	Pre treatment	Post treatment	Notes
Duct insulation	Uninsulated	R-19	Consistent with Smart Saver program requirements
Duct sealing	26% leakage	8% leakage	Duct leakage assumptions used in CA for Title 24 and utility program design. Evenly distributed between

			supply and return

The unit energy and demand savings depend on the heating fuel, heating system, cooling system and duct treatment as follows:

Heating Fuel Other
Heating System Any except Heat Pump
Cooling System None

Duct treatment	ΔkWh/unit	ΔkW/unit	Δtherm/unit
All	0	0	0

Heating Fuel Other
Heating System Any except Heat Pump
Cooling System Central AC

Duct treatment	ΔkWh/unit	ΔkW/unit	Δtherm/unit
Insulate	384	0.10	0
Seal	466	0.25	0

Heating Fuel Any
Heating System Heat Pump
Cooling System Heat Pump

Duct treatment	ΔkWh/unit	ΔkW/unit	Δtherm/unit
Insulate	1,520	0.48	0.0
Seal	2,422	0.78	0.0

Heating Fuel Gas, propane or oil
Heating System Furnace
Cooling System None

Duct treatment	ΔkWh/unit	ΔkW/unit	Δtherm/unit
Insulate	0.0	0.0	17.3
Seal	0.0	0.0	16.5

Heating Fuel Gas, propane or oil
Heating System Furnace
Cooling System Central AC

Duct treatment	ΔkWh/unit	ΔkW/unit	Δtherm/unit
Insulate	384	0.10	17.3
Seal	466	0.25	16.5

Heating Fuel Electricity
Heating System Furnace
Cooling System None

Duct treatment	ΔkWh/unit	ΔkW/unit	Δtherm/unit
Insulate	3,917	3.13	0.0
Seal	3,798	2.98	0.0

Heating Fuel Electricity
Heating System Furnace
Cooling System Central AC

Duct treatment	ΔkWh/unit	ΔkW/unit	Δtherm/unit
Insulate	4,285	3.18	0.0
Seal	4,211	3.18	0.0

Installed a New AC or Heat Pump

Gross Summer Coincident Demand Savings
$\Delta kW_S = (\Delta kW/unit) \times DF_S \times CF_S$

AC = 1.138835274542
Heatpump = 1.552048338369

Gross Annual Energy Savings
ΔkWh = (ΔkWh/unit)

AC = 1375.059900166
Heatpump = 2568.123867069

Δtherm = (Δtherm/unit

AC = 0
Heatpump = 0

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
DF	= demand diversity factor
CF	= coincidence factor
ΔkWunit	`= electricity demand savings per dwelling
ΔkWh/SF	`= electricity consumption savings per dwelling
Δtherm/SF	`= gas consumption savings dwelling

Coincidence and Diversity Factors:

DF = 0.8
CF = 1.0

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for residential air conditioners and heat pumps in summer peaking utilities.

Unit energy and demand savings data

The unit energy and demand savings were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. Unit energy savings are based on replacement of an existing SEER 8.5 air conditioner or heat pump. The unit energy and demand savings depend on the heating fuel, heating system, cooling system and replacement efficiency.

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	None

Replacement efficiency	ΔkWh/unit	ΔkW/unit	Δtherm/unit
All	0	0	0

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	Central AC

Replacement efficiency	ΔkWh/unit	ΔkW/unit	Δtherm/unit
<11	674	0.92	0
12	944	1.28	0
13	1,213	1.65	0
14+	1,346	1.80	0

Heating Fuel Any
Heating System Heat Pump
Cooling System Heat Pump

Replacement efficiency	ΔkWh/unit	ΔkW/unit	Δtherm/unit
<11	2,941	1.36	0
12	2,941	1.36	0
13	5,294	2.45	0
14+	6,496	2.98	0

Heating Fuel Gas, propane or oil
Heating System Any except Heat Pump
Cooling System None

Replacement efficiency	ΔkWh/unit	ΔkW/unit	Δtherm/unit
All	0.0	0.0	0

Heating Fuel Gas, propane or oil
Heating System Any except Heat Pump
Cooling System Central AC

Replacement efficiency	ΔkWh/unit	ΔkW/unit	Δtherm/unit
<11	674	0.92	0
12	944	1.28	0
13	1,213	1.65	0
14+	1,346	1.80	0

0

Heating Fuel Electricity
Heating System Any except Heat Pump
Cooling System None

Replacement efficiency	ΔkWh/unit	ΔkW/unit	Δtherm/unit
All	0.0	0.0	0

Heating Fuel Electricity
Heating System Any except Heat Pump

Cooling System Central AC

Replacement efficiency	ΔkWh/unit	ΔkW/unit	Δtherm/unit
<11	674	0.92	0
12	944	1.28	0
13	1,213	1.65	0
14+	1,346	1.80	0

Installed a New Furnace

Gross Annual Energy Savings
Δtherm = (Δtherm/unit)
=16.34529540481

where:

Δtherm/SF `= gas consumption savings dwelling

Unit energy and demand savings data

The unit energy and demand savings were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. The basic assumptions are listed below:

Furnace Type	AFUE
Baseline	0.78
Standard efficiency (metal flue pipe) replacement	0.80
Condensing furnace (plastic flue pipe) replacement	0.90

The unit energy and demand savings depend on the heating fuel, heating system type, and replacement furnace type:

Heating Fuel Gas, propane or oil
Heating System Furnace

Replacement efficiency	Δtherm/unit
Standard (metal pipe)	3.0
Condensing (plastic pipe)	18.8

Otherwise 0

Prototypical Building Model Description

The impact analysis for many of the HVAC related measures are based on DOE-2.2 simulations of a set of prototypical residential buildings. The prototypical simulation models were derived from the residential building prototypes used in the California Database for Energy Efficiency Resources (DEER) study (Itron, 2005), with adjustments make for local building practices and climate. The prototype "model" in fact contains 4 separate residential buildings; 2 one-story and 2 two-story buildings. The each version of the 1 story and 2 story buildings are identical except for the orientation, which is shifted by 90 degrees. The selection of these 4 buildings is designed to give a reasonable average response of buildings of different design and orientation to the impact of energy efficiency measures. A sketch of the residential prototype buildings is shown in Figure 9.

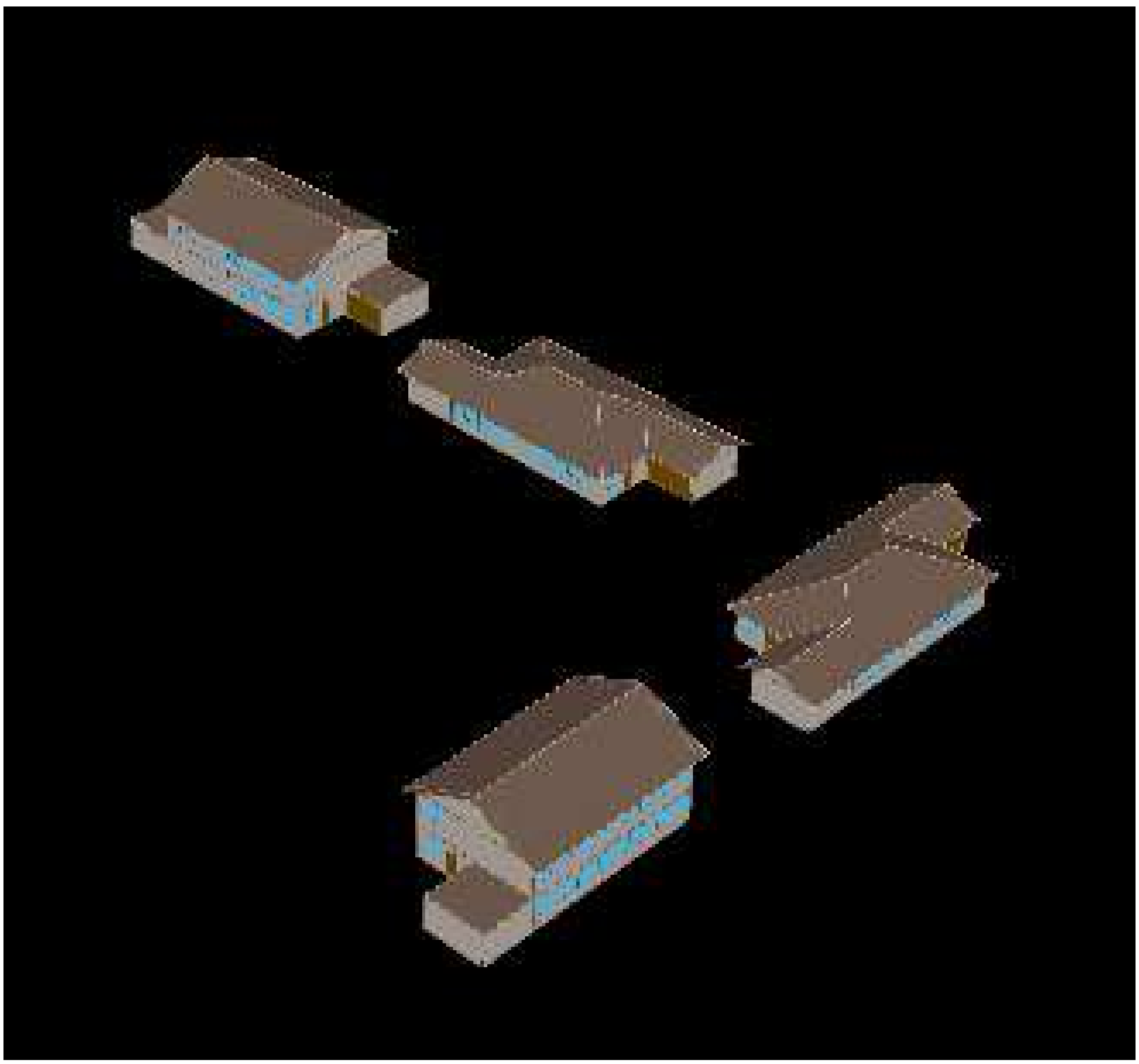

Figure 9. Computer Rendering of Residential Building Prototype Model

The general characteristics of the residential building prototype model are summarized below:

Residential Building Prototype Description

Characteristic	Value
Conditioned floor area	1 story house: 1465 SF 2 story house: 2930 SF
Wall construction and R-value	Wood frame with siding, R-11
Roof construction and R-value	Wood frame with asphalt shingles, R-19
Glazing type	Single pane clear
Lighting and appliance power density	0.51 W/SF average
HVAC system type	Packaged single zone AC or heat pump
HVAC system size	Based on peak load with 20% oversizing. Average 640 SF/ton
HVAC system efficiency	SEER = 8.5
Thermostat setpoints	Heating: 70°F with setback to 60°F Cooling: 75°F with setup to 80°F
Duct location	Attic (unconditioned space)
Duct surface area	Single story house: 390 SF supply, 72 SF return Two story house: 505 SF supply, 290 SF return
Duct insulation	Uninsulated
Duct leakage	26%; evenly distributed between supply and return
Cooling season	Charlotte – April 17 to October 6 Covington
Natural ventilation	Allowed during cooling season when cooling setpoint exceeded and outdoor temperature < 65°F. 3 air changes per hour

References

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EPRI, 1993. Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2: Fundamental Equations for Residential and Commercial End-Uses, EPRI TR-100984 V2., Electric Power Research Institute, Palo Alto, CA. 1993.

Itron, 2005. "2004-2005 Database for Energy Efficiency Resources (DEER) Update Study, Final Report," Itron, Inc., J.J. Hirsch and Associates, Synergy Consulting, and Quantum Consulting. December, 2005. Available at http://eega.cpuc.ca.gov/deer

Appendix B: Program Manager Interview Instrument

Name: ____

Title: ____

Position description and general responsibilities:

____

____

____

We are conducting this interview to obtain your opinions about and experiences with the Home Energy House Call program. We'll talk about the Home Energy House Call Program and its objectives, your thoughts on improving the program, and the technologies the program covers. The interview will take about an hour to complete. May we begin?

Program Objectives

1. In your own words, please describe the Home Energy House Call's current objectives. How have these changed over time?

2. In your opinion, which objectives do you think are best being met or will be met?

3. Are there any program objectives that are not being addressed or not being addressed as well as possible or that you think should have more attention focused on them? If yes, which ones? How should these objectives be addressed? What should be changed?

4. Should the program objectives be changed in any way due to technology-based, market-based, or management based conditions? What objectives would you change? What program changes would you put into place as a result, and how would it affect the operations of the program?

Operational Efficiency

5. Please describe your role and scope of responsibility in detail. What is it that you are responsible for as it relates to this program?

6. Please review with us how the Home Energy House Call operates relative to your duties, that is, please walk us through the processes and procedures and key events that allow you do currently fulfill your duties.

7. Have any recent changes been made to your duties? If so, please tell us what changes were made and why they were made. What are the results of the change?

8. Describe the evolution of the Home Energy House Call Program. How has the program changed since it was it first started?

9. Do you have suggestions for improvements to the program that would increase participation rates or interest levels?

10. Do you have suggestions for improving or increasing energy impacts?

11. Do you have suggestion for the making the program operate more smoothly or effectively?

Program Design & Implementation

12. *(If not captured earlier)* Please explain how the interactions between the auditors, customers and Home Energy House Call's management team work. Do you think these interactions or means of communication should be changed in any way? If so, how and why?

13. Describe your quality control and tracking process.

14. Are key industry experts, trade professionals or peers used for assessing what the technologies or models should be included in the program? If so, how does this work?

15. Are key industry experts and trade professionals used in other advisory roles? If so how does this work and what kinds of support is obtained?

16. Describe Home Energy House Call**'s** auditor program orientation training and development approach. Are auditors getting adequate program training and program information? What can be done that could help improve auditor effectiveness? Can we obtain training materials that are being used?

17. In your opinion, do the audits cover enough different kinds of energy efficient products or recommendations?

    1. ❑ Yes 2. ❑ No 99. ❑ DK/NS

    If no, 20b. What other products or equipment should be included? Why?

---

18. What market information, research or market assessments are you using to determine the best target markets or market segments to focus on?

19. What market information, research or market assessments are you using to identify market barriers, and develop more effective delivery mechanisms?

20. Overall, what about the Home Energy House Call program works well and why?

21. What doesn't work well and why? Do you think this discourages participation or interest?

22. Can you identify any market, operational or technical barriers that impede a more efficient program operation?

23. In what ways can these operations or operational efficiencies be improved?

24. In what ways can the program attract more participants?

25. How do you make sure that the best information and practices are being used in Home Energy House Call operations?

26. *(If not collected above)* What market information, research or market assessments are you using to determine the best target markets and program opportunities, market barriers, delivery mechanisms and program approach?

27. If you had a magic wand, what one thing would you change and why?

28. Are their any other issues or topics you think we should know about and discuss for this evaluation?

Appendix C: Participant Survey Protocol

The questions below require mostly short, scaled replies from the interviewee, and not all questions will be asked of all participants. This interview should take approximately 10 to 15 minutes.

Home Energy House Call Program

Participant Survey

Contact Module
SURVEY INTRODUCTION

If Home Energy House Call participant, then contact for survey. Use seven attempts at different times of the day and different days before dropping from contact list. Call times are from 10:00 a.m. to 8:00 p.m. EST or 9-7 CST Monday through Saturday. No calls on Sunday. (Sample size N =150-200)

SURVEY

Introduction

Note: Only read words in bold type.

Hello, my name is ______. I am calling on behalf of Duke Energy to conduct a customer survey about the Home Energy House Call Program. May I speak with _____________ please?
If person talking, proceed. If person is called to the phone reintroduce.
If not home, ask when would be a good time to call and schedule the call-back:

Call back 1: Date: ___________, Time: ______________ ❑AM or ❑PM
Call back 2: Date: ___________, Time: ______________ ❑AM or ❑PM
Call back 3: Date: ___________, Time: ______________ ❑AM or ❑PM
Call back 4: Date: ___________, Time: ______________ ❑AM or ❑PM
Call back 5: Date: ___________, Time: ______________ ❑AM or ❑PM
Call back 6: Date: ___________, Time: ______________ ❑AM or ❑PM
Call back 7: Date: ___________, Time: ______________ ❑AM or ❑PM
❑ Contact dropped after seventh attempt.

We are conducting this survey to obtain your opinions about the Home Energy House Call Program. Duke Energy's records indicate that you participated in the Home Energy House Call Program. We are not selling anything. The survey will take about 10 minutes and your answers will be confidential, and will help us to make improvements to the program to better serve others. May we begin the survey?

Note: If this is not a good time, ask if there is a better time to schedule a callback.

1. **Do you recall participating in the Home Energy House Call Program?**

1. ❑ Yes, *begin* → *Skip to Q3.*
2. ❑ No,
99. ❑ DK/NS

This program was provided through Duke Energy. In this program, you registered to receive a home energy audit. In return, the auditors provided you with custom energy-saving recommendations for you and your home, and you were provided with a free energy efficiency kit with 10 measures, such as a low-flow showerhead, CFLs, and outlet gaskets.

Do you remember participating in this program?

1. ❑ Yes, *begin* → *Go to Q2.*
2. ❑ No,
99. ❑ DK/NS

If No or DK/NS terminate interview and go to next participant.

2. Please think back to the time when you were deciding to participate in the Home Energy House Call program. What factors motivated you to participate? **(*do not read list, place a "1" next to the response that matches best)***

1. _____ The audit
2. _____ The energy efficiency kit
3. _____ The program incentives
4. _____ The technical assistance from the auditor
5. _____ Recommendation of someone else (*Probe*: **Who?**___________)
6. _____ Wanted to reduce energy costs
7. _____ The information provided by the Program
8. _____ Past experience with this program
9. _____ Because of past experience with another Duke Energy program
10. _____ Recommendation from other utility program

i. (*Probe*: **What program?** ____________________________)

11. ____ Recommendation of family/friend/neighbor
12. ____ Advertisement in newspaper (*Probe:* **For what program?** ___________)
13. ____ Radio advertisement (*Probe:* **For what program?** ___________)
14. ____ Other (SPECIFY) ____
15. ____ Don't know/don't remember/not sure (DK/NS)

If multiple responses: 2.a. **Were there any other reasons?** *(number responses above in the order they are provided - Repeat until 'no' response.)*

Free-Ridership Questions

3. **Before you heard about the Home Energy House Call from Duke Energy, had you already been considering getting a home energy audit?**

1. ❑ Yes
2. ❑ No
3. ❑ Don't Know

4. **If the audit from Duke Energy's Home Energy House Call Program had not been available, would you still have:**

4a. **Purchased an audit?**

1. ❑ Yes
2. ❑ No – *skip to question 5*
3. ❑ Don't Know – *skip to question 5*

4b. **Would you have purchased the audit within the next year?**

1. ❑ Yes
2. ❑ No
3. ❑ Don't Know

5. **Now I'd like to talk about the energy efficiency kit that you received for participating in the Home Energy House Call program. I'm going to read a list of the items included in the kit, and for each one, please tell me if you have installed the item. Are you using the…**

5a. **15-watt CFL** ❑ Yes – *triggers follow up questions 6a-6d.*

❑ No **Do you plan on using this item?** ❑ Yes – *triggers 6a-6d*.
❑ No ❑ Maybe/DK

❑ DK

5b. **20-watt CFL** ❑ Yes – *triggers follow up questions 6a-6d*.

❑ No **Do you plan on using this item?** ❑ Yes – *triggers 6a-6d*.
❑ No ❑ Maybe/DK

❑ DK

5c. **Low-flow showerhead** ❑ Yes – *triggers follow up questions 7a-7d*

❑ No **Do you plan on using this item?** ❑ Yes – *triggers 7a-7d*.
❑ No ❑ Maybe/DK

❑ DK

5d. **kitchen faucet aerator** ❑ Yes – *triggers follow up questions 8a-8d*

❑ No **Do you plan on using this item?** ❑ Yes – *triggers 8a-8d*.
❑ No ❑ Maybe/DK

❑ DK

5e. **bathroom faucet aerator** ❑ Yes – *triggers follow up questions 8a-8d*

❑ No **Do you plan on using this item?** ❑ Yes – *triggers 8a-8d*.
❑ No ❑ Maybe/DK

❑ DK

5f. **outlet gaskets** ❑ Yes – *triggers follow up questions 9a-9d*

❑ No **Do you plan on using this item?** ❑ Yes – *triggers 9a-9d*.
❑ No ❑ Maybe/DK

❑ DK

5g. **window shrink kit** ❑ Yes – *triggers follow up questions 10a-10d*

❑ No **Do you plan on using this item?** ❑ Yes – *triggers 10a-10d*.
❑ No ❑ Maybe/DK

❑ DK

5h. **weather stripping** ❑ Yes – *triggers follow up questions 11a-11d*

❑ No **Do you plan on using this item?** ❑ Yes – *triggers 11a-11d.*
❑ No ❑ Maybe/DK

❑ DK

6a. **Did you have any CFLs installed in your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ DK

6b. **Were you planning on buying** <additional> **CFLs for your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ Maybe ❑ DK

❑ No, already have them installed in all available sockets – *skip to next series*

6c. **Have you purchased any CFLs since receiving the kit from Home Energy House Call?**

❑ Yes ❑ No ❑ DK

If yes, 6d. **How many?** ____________________

7a. **Did you have any low-flow showerheads installed in your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ DK

7b. **Were you planning on buying a low-flow showerhead for your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ Maybe ❑ DK

❑ No, already have them installed in all showers – *skip to next series*

7c. **Have you purchased any additional low-flow showerheads since receiving the kit from Home Energy House Call?**

❑ Yes ❑ No ❑ DK

If yes, 7d. **How many?** ___________________

8a. **Did you have any faucet aerators installed in your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ DK

8b. **Were you planning on buying any faucet aerators for your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ Maybe ❑ DK

❑ No, already have them installed in all available faucets – *skip to next series*

8c. **Have you purchased any additional faucet aerators since receiving the kit from Home Energy House Call?**

❑ Yes ❑ No ❑ DK

If yes, 8d. **How many?** ___________________

9a. **Did you have any outlet gaskets installed in your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ DK

9b. **Were you planning on buying any outlet gaskets for your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ Maybe ❑ DK

❑ No, already have them installed in all available outlets – *skip to next series*

9c. **Have you purchased any additional outlet gaskets since receiving the kit from Home Energy House Call?**

❑ Yes ❑ No ❑ DK

If yes, 9d. **How many?** ___________________

10a. **Did you have any window shrink kits installed in your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ DK

10b. **Were you planning on buying any window shrink kits for your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ Maybe ❑ DK

❑ No, already have them installed in all available windows – *skip to next series*

10c. **Have you purchased any additional window shrink kits since receiving the kit from Home Energy House Call?**

❑ Yes ❑ No ❑ DK

If yes, 10d. **For how many windows?**

____

11a. **Did you have any weather stripping installed in your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ DK

11b. **Were you planning on buying any weather stripping for your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ Maybe ❑ DK

❑ No, already have them installed around all available doors – *skip to next series*

11c. **Have you purchased any additional weather stripping since receiving the kit from Home Energy House Call?**

❑ Yes ❑ No ❑ DK

If yes, 11d. **For how many doors?**

____

Spillover Questions

12. **Since you participated in the Home Energy House Call Program, have you purchased and installed any other type of energy efficiency equipment or made energy efficiency improvements in your home that were recommended by the audit report?**

1. ❑ Yes
2. ❑ No
3. ❑ Don't Know

13. **What type and quantity of high efficiency equipment did you install on your own?** *PROBE TO GET EXACT TYPE AND QUANTITY AND LOCATION*

Type 1: ____________________	Quantity 1: ______	Location 1:____________
Type 2: ____________________	Quantity 2: ______	Location 2:____________
Type 3: ____________________	Quantity 3: ______	Location 3:____________
Type 4: ____________________	Quantity 4: ______	Location 4:____________

14. **Was this improvement suggested by the home energy audit provided to you through the Home Energy House Call program?**

Type 1: ____________________	❑ Yes	❑ No	❑ DK
Type 1: ____________________	❑ Yes	❑ No	❑ DK
Type 1: ____________________	❑ Yes	❑ No	❑ DK
Type 1: ____________________	❑ Yes	❑ No	❑ DK

15. *For each type listed in 13 above,* **How do you know that this equipment is high efficiency? For example, was it Energy Star rated?**

Type 1: ____
Type 2: ____
Type 3: ____
Type 4: ____

I'm going to read a statement about this equipment that you purchased on your own. On a scale from 1-10, with 0 indicating that you strongly disagree, and 10 indicating that you strongly agree, please rate the following statement.

16. **My experience with the Home Energy House Call Program in** <2006, 2007, 2008> **influenced my decision to install** <Type 1/Type 2/Type 3/Type 4> **on my own.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

17. **What other actions, if any, have you taken in your home to save energy and reduce utility bills at least in part as a result of what you learned in this program?**
Response:1 ____________________

Response:2 ____________________

Response:3 ____________________

Response:4 ____________________

Now I am going to ask you some general satisfaction statements. On a scale from 1-10, with 0 indicating that you strongly disagree, and 10 indicating that you strongly agree, please rate the following statements.

18. **The web site's form for getting the kit was easy to understand and complete**.

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?____________________

____

19. **Scheduling the home energy audit was easy to do.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?____________________

____

20. **The interactions and communications I had with the energy auditor were satisfactory.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know ❑ Not Applicable (no interaction)

If 7 or less, **How could this be improved**?____________________

____

21. **The energy auditor was friendly, helpful, and knowledgeable.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know ❑ Not Applicable (no interaction)

If 7 or less, **How could this be improved**?____

22. **The audit report was easy to read and understand.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?____

23. **The recommendations in the audit report provided new ideas that I was not previously considering.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?____

24. **The recommendations in the audit report confirmed by thinking and increased the likelihood that I would take recommended actions.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?____

25. **The interactions and communications I had with Duke Energy staff was satisfactory.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know ❑ Not Applicable (no interaction)

If 7 or less, **How could this be improved**?______________________________________

____

26. **The measures I installed from in the energy efficiency kit were of satisfactory quality.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?______________________________________

____

27. **Overall I am satisfied with the program**.

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved**?______________________________________

____

28. What additional services would you like the program to provide that it does not now provide?
Response:

____

____

29. Are there any other things that you would like to see changed about the program?

Response:

____

30. **What do you think can be done to increase people's interest in participating in the Home Energy House Call Program?**

Response:1 ____
Response:2 ____
Response:3 ____
Response:4 ____

32. What do you like most about this program?

Response:

____

33. What do you like least about this program?

Response:

____